THE

# ELECTRICAL REVIEW.

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THE

**UNIVERSAL ELECTRICAL DIRECTORY**

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## THE SOUTH STAFFORDSHIRE POWER SCHEME.

THE South Staffordshire power scheme has entered upon a new stage of its somewhat chequered career in being bought up by a company, which has Mr. Atherton for its principal backer. As some of our readers well know, this gentleman has come much to the front of late in connection with the British Insulated Wire Company, of Prescot, and we may now confidently expect that there will be a rapid development of the powers which the Transmission Company undoubtedly possess. South Staffordshire is practically one huge town, and the multitude of small and varied industries which will always be carried on, combined with the proximity of all raw materials, makes this area one of the most promising in Great Britain for the application of electric transmission of power. If the distribution of electrical energy from a steam-driven central station is to pay at all, then surely South Staffordshire is the place. The various local authorities have been exceedingly perverse in one or two cases, the opposition shown being apparently inversely proportional to the importance of the township, but we cannot help thinking that our friends across the water or the Swiss or Germans, if they had had such a plum in their midst, would have had the alternators turning round before now.

However, we must give Mr. Addenbrooke, and those associated with him, credit for having done their best to pioneer the company through its early stages as quickly as was possible under the circumstances. What is wanted now is some bold financing on the American and German lines, and Mr. Atherton's entrance at this stage is a sign of good omen. It practically means, of course, that the cables will be made at Prescot, and as the cable manufacturer has the greatest stake in a matter of this kind, naturally the promoter will see that the cables are made by the company in which he is interested.

We learn that Messrs. Kincaid, Waller & Manville are appointed consulting engineers, and as this is one of the firms who keep a capable electrical engineering staff, we feel sure that the drawing up of the specifications is in good hands.

Mr. Thomas Parker is, we understand, connected with the new company, but although high tension continuous current has been talked of in connection with the scheme for some time, it is now definitely shelved in favour of multiphase alternating current. Four units of 2,000 KW. and two of 1,000 KW. are to be laid down as a start, and we can only hope that by the time the work is given out to tender, some of our British firms will have got their new shops finished and be in a position to deliver these large units within a reasonable time. It will only be human nature to find that after spending four years in talk, South Staffordshire Bumbledom will look for all the machinery to be delivered and erected in as many months after date of order. Perhaps, however, as some of the directors are manufacturers them-

selves, the delivery and penalty clauses will be reasonably drafted, and with a view to placing the work in this country.

We note that the new company has not seen its way to retain Mr. Addenbrooke's services. His cautiousness is perhaps too strongly developed for work which, if it is to be done at all must be tackled boldly, but having once decided to go right ahead on certain definite lines, there were a good many minor points requiring local knowledge, in which the late consulting engineer could have materially assisted the company. The inception of the idea of supplying South Staffordshire with electric power was due to Mr. Addenbrooke, and in the days when some of those now closely interested thought it a Utopian idea, he and Mr. E. Kilburn Scott were laboriously collecting together all the information available and preparing estimates of costs, &c., in such a way that they would appeal to those able to give the necessary financial support.

With good management we are sure that power transmission on a large scale from a steam-driven plant will succeed, and we look forward to the time when we shall be able to describe and illustrate the plant laid down for the wholesale distribution of electrical energy in South Staffordshire.

## ELECTRIC TRACTION PROGRESS IN LONDON.

The decision of the London County Council to *experiment* with electric traction renders the present a very fitting opportunity for reviewing the important electric traction projects under construction in the metropolis.

In the course of a few months the City and South London Railway extensions to Moorgate Street and Clapham will be completed, and we hope that the anticipations which have been cherished by the board, of enormous traffic bringing increased dividends to the ordinary stockholders, will be fully realised, for the patience which they have shown year after year with the small interest declared, deserves to be well rewarded. Furthermore, the cordial way in which shareholders of this undertaking meet their directors at half-yearly meetings affords very powerful evidence that they are satisfied that no stone has been left unturned to bring things to a successful issue. The very interesting percentage figures which have been produced by the chairman with clockwork regularity at every meeting, showing the steady decrease in working expenses and the continual increase in receipts per train mile and per passenger, have been an eloquent testimonial to excellent management. The capital outlay upon such lines as the company is now completing is, of course, very heavy, but we are hopeful, when the Bank connection with other railway systems is working and the Islington extension—just commenced—is bringing in the very large receipts which may be reasonably expected, that the small dividend declared for the first half of the present year, viz., 2¼ per cent., will be doubled or trebled.

Turning to other lines, the date for the inauguration of the Central London Railway to Shepherd's Bush seems to be as uncertain as ever. The directors' statement, of course, shows progress in the carrying out of the various works connected with the power station and line work, yet, though things are in a forward state, we shall not for some months be able to announce the opening of the railway for traffic. The undertaking possesses many extremely interesting features, as has been already indicated in our columns, and English electrical engineers will welcome its completion with as much enthusiasm as will the travelling public, to whom it cannot fail to be of great convenience.

The Great Northern and City Railway Company announced last week that contracts for the necessary tunnelling works had been placed and these are making progress. But among the more interesting works of the underground kind is the experimental electrical section of the Metropolitan and Metropolitan District Railways. The managing director does not wish it to be thought that the electrical equipment of the entire lines can be taken in hand immediately, but a couple of months will witness the completion of the experimental line, and that is something to be thankful for. The ultimate result is pretty certain. Let us hope that when the work is taken in hand in earnest, English contractors will carry off the contracts. The two underground electric lines now running—the City and South London, and the Waterloo and City (as yet undescribed by the electrical journals)—have shown what English manufacturers can do in the direction of traction plant. The Metropolitan experimental machinery is of English make, and we do not doubt that the subsequent equipment will be also of home manufacture.

Developments, however, are not confined to underground railways, for the very interesting undertaking of the London United Tramways Company is, so to speak, on the eve of completion. Had there been no London County Council, we should have had many miles of electric tramways running in London years ago, and what that body has not done to oppose the application of electric traction has not been worth the doing. While the London United has been actually constructing its West London lines, the Spring Gardens company has been deliberating as to whether the time had arrived even for *experimenting!* It is a pity that the necessary experimenting was not taken in hand several years ago, when councillors were pleased to fling their diatribes at the overhead trolley system; we might now be reaping the benefit instead of wasting time experimenting with surface contact systems and equipping a trial conduit section. But there, we must be thankful that the Progressive body has at last made progress, though that progress may be very small. The conduit and surface contact system for which the Council's officials are now preparing plans and estimates at a cost of £10,000 will be of great interest to electrical engineers and tramway men both during construction and on completion, but we are afraid that there may be still a feeling in the Council that the equipment of other lines should not be taken in hand until the permanent experimental line has been operating for some months. This may apply to the central thoroughfares, but there seems no earthly reason why the Council should not proceed forthwith with the trolley equipment of the lines on the outskirts. There are rumours of a proposed outlay of a million sterling very shortly. We hope there is truth in the rumour, and that the London Council, which exercises its influence in so autocratic a fashion in labour clauses on behalf of the British workman, will see that English contractors are allowed to carry out the greater share of the work in English electrical factories, thereby benefiting the electrical industry of this country, and, in consequence, the workmen engaged therein.

# THE GENERATION OF POWER FOR ELECTRIC TRACTION.

By J. GRAY SCOTT.

(*Continued from page* 80.)

The regulations issued by the Board of Trade under the provisions of the Tramways Act have already been mentioned, and in conjunction with these, a special panel of the switchboard is usually reserved, and equipped with the necessary instruments.

While these regulations are sometimes considered too stringent, there is no doubt that their requirements may easily be met in any well-constructed tramway system—their observance practically resolving itself into a guarantee of the proper equipment and construction of the line.

The principal trouble, to obviate which these regulations have been framed is, of course, electrolysis; but generally speaking, this has become a thing of the past.

The earlier experiences are too well known to need recapitulation, but the fact that the advantage of thoroughly sound construction assumes *practical* importance is borne out by the following extract from a report by a special commissioner of the *Glasgow Herald*, who visited America a few years ago with the express purpose of investigating the question of electric traction.

As the matter is more or less of direct interest, the author quotes the paragraph *in extenso*:—

Mr. A. Langstaff Johnston has been engineer for the equipment of a number of electric street lines, and his views are important.

He was engineer of the original Richmond (Virginia) electric line, which was the first practicable thing of the country.

It was built in 1887, and equipped by Mr. Frank Sprague.

There were 12 miles of track and 40 cars.

This was the example of the new style of traction which engineers from all over the world came to see.

Mr. Johnston was connected with the equipment, in 1892, of the New Orleans and Carlton road.

In 1891, the gross receipts from horse traction were $175,000. In 1893, when electricity had been installed, the takings rose to $429,000 for the same length of track, viz., 20 miles.

The total expenses, meantime, despite the increase of business, rose only about 25 per cent.

On the question of working expenses, Mr. Johnston is firmly convinced that many companies are still losing a lot of money through defective return circuits.

On one line, 10 miles long, he found, three years ago, that at the fastest speed obtainable, the journey took an hour.

By improving the rail bonding and feeder system, *the time was cut down to* 20 *minutes, and there was a saving in the coal bill of* $300 *per month.*

The road, it is hardly necessary to say, was a suburban one, but the lesson is the importance of perfect construction, and of employing experienced men.

Presuming this to be an extreme case, it is nevertheless quite apparent that the efficiency of the system must largely depend upon the sound construction and percentage conductivity of the return circuit.

The *raison d'être* of the special panel will be best explained by the following extract from the regulations issued by the Board of Trade:—

2. One of the two conductors used for transmitting energy from the generator to the motor shall be in every case insulated from earth, and is hereinafter referred to as the "line;" the other may be insulated throughout, or may be uninsulated in such parts, and to such extent, as is provided in the following regulations, and is hereinafter referred to as the "return."

3. Where any rails on which cars run, or any conductors laid between or within 3 feet of such rails form any part of a return, such part may be uninsulated.

All other returns, or parts of a return, shall be insulated, unless of such sectional area as will reduce the difference of potential between the ends of the uninsulated portion of the return below the limit laid down in Regulation 7. . . .

5. When any part of a return is uninsulated, it shall be connected with the negative terminal of the generator, and in such case the negative terminal of the generator shall also be directly connected, through the current indicator hereinafter mentioned, to two separate earth connections, which shall be placed not less than 20 yards apart. . . .

The earth connections referred to in this regulation shall be constructed, laid, and maintained so as to secure electrical contact with the general mass of earth, and so that an electromotive force, not exceeding 4 volts, shall suffice to produce a current of at least 2 amperes from one earth connection to the other through the earth, and a test shall be made at least once in every month to ascertain whether this requirement is complied with. . . .

6. When the return is partly or entirely uninsulated, the company shall, in the construction and maintenance of the tramway (A) so separate the uninsulated return from the general mass of earth, and from any pipe in the vicinity; (B) so connect together the several lengths of rails; (C) adopt such means for reducing the difference produced by the current between the potential of the uninsulated return at any one point and the potential of the uninsulated return at any other point; (D) so maintain the efficiency of the earth connections specified in the preceding regulations as to fulfil the following conditions, viz:—

(i.) That the current passing from the earth connections through the indicator to the generator shall not at any time exceed either 2 amperes per mile of single tramway line, or 5 per cent. of the total current output of the station.

(ii.) That if at any time, and at any place, a test be made by connecting a galvanometer or other current indicator to the uninsulated return and to any pipe in the vicinity, it shall always be possible to reverse the direction of any current indicated by interposing a battery of three Leclanché cells connected in series if the direction of the current is from the return to the pipe, or by interposing one Leclanché cell if the direction of the current is from the pipe to the return.

In order to provide a continuous indication that condition (i.) is complied with, the company shall place in a conspicuous position a suitable, properly connected, and correctly marked current indicator, and shall keep it connected during the whole time that the line is charged. . . .

7. When the return is partly or entirely uninsulated, a continuous record shall be kept by the company of the difference of potential during the working of the tramway between the points of the uninsulated return furthest from and nearest to the generating station.

If at any time such difference of potential exceeds the limit of 7 volts, the company shall take immediate steps to reduce it below that limit. . . .

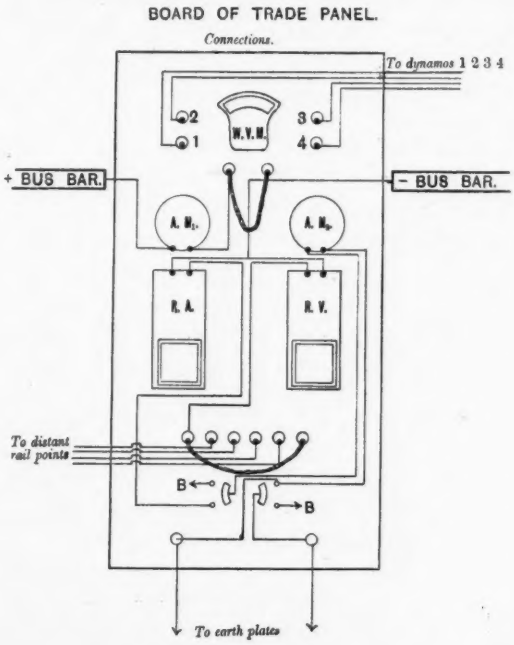
10. The insulation of the line, and of the return when insulated, and of all feeders and other conductors, shall be so maintained that the leakage current shall not exceed one-hundreth of an ampere per mile of tramway.

The leakage current shall be ascertained daily before or after the hours of running, when the line is fully charged.

If at any time it should be found that the leakage current exceeds one-half of an ampere per mile of tramway, the leak shall be localised and removed as soon as practicable, and the running of the cars shall be stopped, unless the leak is localised and removed within 24 hours. . . .

11. The insulation resistance of all continuously insulated cables used for lines, for insulated returns, for feeders, or for other purposes, and laid below the surface of the ground, shall not be permitted to fall below the equivalent of 10 megohms for a length of 1 mile.

A test of the insulation resistance of all such cables shall be made at least once in each month.




The accompanying diagram, though not to scale, shows the general arrangement of the panel, and the connections of the various instruments thereon.

W V M indicates the main station voltmeter, which was temporarily fitted in this position, but, as already mentioned, has now been erected on a swinging bracket at the right hand extremity of the board.

This voltmeter is of the Weston type, and ranges from zero to 600 volts.

Immediately below this instrument will be noticed a plug fitting and flexible connected through A $M_1$ to the + bus bar.

The plug may be inserted in any of the four contacts numbered 1, 2, 3, 4 respectively, and each connected to the + pole of the corresponding generator.

The test is made with the generator at proper voltage but with main switches off, when the reading on the ammeter gives directly the line leakage, and indirectly the insulation resistance of the system.

Precautions should be taken, of course, to have all lamps switched off and trolley poles removed from contact with the line.

The ammeter has two ranges, viz., 0—·05 and 0—·5 respectively.

This test is taken in accordance with Regulation 10.

A $M_2$ is an ammeter reading 1—10 amperes, and deals with Regulations 5 and 6 (i.).

The former stipulates that the contact of the earth plates with the general mass of earth should be such, that an E.M.F., not exceeding 4 volts, shall suffice to produce a current of at least 2 amperes from one earth connection to the other.

The necessary E.M.F. may be procured by two ordinary Leclanché cells, mounted on a bracket behind the board, and connected (in series) with the two contacts of the two-way switch indicated by B B.

This two-way switch is arranged with a contact block and two contact studs on either side; the contact blocks are always in circuit, and are connected with each of the two adjacent studs in turn.

For the first test (Regulation 5) the position of the switch would be diagonal, as indicated across B B, and presuming B on the left to represent the + pole of the battery, the circuit would be as follows:—

From B (left) to contact block, through A $M_2$ to left earth plate, thence to right-hand earth plate, and from the other contact block to B (right), which is negative pole of the battery.

To take the other test (Regulation 6, i.), we simply turn the switch to the other diagonal position, bringing into circuit the recording ammeter, R A, and simultaneously putting the earth plates in parallel with each other.

It will be well to follow out the connections:—Starting at the two earth plates, the current passes through A $M_2$ as before, thence to the left contact block and lower contact stud through the recording ammeter, R A, and so to the — bus bar.

The recording voltmeter, R V, is required by Regulation 7 to give a continuous indication of the drop in volts between various points on the rails and the — bus bar at the station.

The four plug contacts shown are connected to the furthest and nearest points and two intermediate points on the return.

The two recording instruments, which are of Messrs. Elliott Bros. latest pattern, are each of range 0—10.

These give a continuous record of the required tests, and as already pointed out, there is no difficulty in keeping within the prescribed limits in a properly contructed system.

(*To be continued.*)

## INSTALLATION ESTIMATES.

(*Concluded from page* 167.)

TABLE II. gives the extra cost if accumulators are used. For installations at home glass boxes are used, but for shipping orders lead-lined teak boxes are necessary. The sulphuric acid must be quite free from chlorine, nitrogen, iron, arsenic or zinc, and it is generally advisable to send it out with the battery rather than trust to local merchants. The price at home is about 3½d. per gallon, but the freight and insurance rates on carboys of acid are very high, and therefore before deciding on whether to use a battery abroad it is necessary to inquire fully into the question of freight, and the kind of handling that the material will get at its destination.

TABLE II.—ADDITIONAL PRICE IF ACCUMULATORS ARE REQUIRED.

| — | — | 25 lamps. | 50 lamps. | 75 lamps. | 100 lamps. | 150 lamps. | 200 lamps. | 300 lamps. |
|---|---|---|---|---|---|---|---|---|
| Cells ... | One set of 58 cells capable of supplying 16 C P 110-volt lamps. Complete with acid, bottom blocks, glass fluid insulators and oil, connecting bolts; and also wood supporting strips and hydrometers. | For 20 lamps for 6 hours. | For 32 lamps for 6 hours. | For 50 lamps for 6 hours. | For 60 lamps for 6 hours. | For 80 lamps for 6 hours. | For 115 lamps for 6 hours. | For 155 lamps for 6 hours. |
| Dynamo ... | Dynamo to be shunt-wound and increased in size to give 140 volts for charging the battery; also shunt resistance. | | | | | | | |
| Switchboard | The switchboard to have added to it:—One charge and discharge switch, 12-way; one ammeter switch, 2-way; one automatic cut-out, and one single-pole battery fuse. | | | | | | | |
| Cable ... | The following additional cable, casing, &c., will also be required:— | | | | | | | |
| | Insulated cable... ... ... ... ... ... | 220 yds. 18 350 ft. 2 ins. 4 gross. | 220 yds. 7/8 350 ft. 2½ ins. 4 gross. | 220 yds. 1/8 350 ft. 2½ ins. 4 gross. | 220 yds. 1/7 350 ft. 3½ ins. 4 gross. | 220 yds. 1/8 350 ft. 3½ ins. 4 gross. | 220 yds. 1/8 350 ft. 4 ins. 5 gross. | 220 yds. 1/8 350 ft. 4 ins. 5 gross. |
| | Casing and capping ... ... ... ... ... | | | | | | | |
| | Assorted screws ... ... ... ... ... | | | | | | | |
| | Total extra price ... | £105 | £125 | £150 | £175 | £200 | £240 | £300 |
| Total weight of above material ... ... ... ... | | 38 cwts. | 45 cwts. | 60 cwts. | 75 cwts. | 90 cwts. | 105 cwts. | 140 cwts. |

### Cost of Wiring, &c.

The cost of wiring is a very variable quantity on account of the labour in drilling through walls and making good, &c. The larger the installation the less is the price per point; this is shown in fig. 6 which gives an average price. Fig. 7

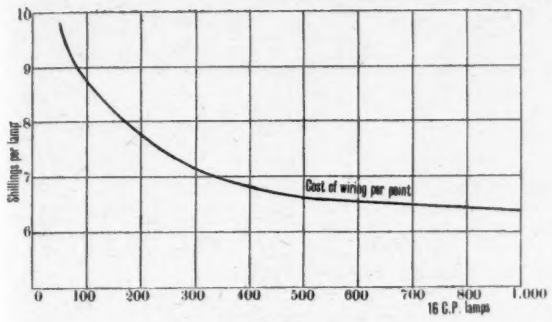



Fig. 6.

gives the total cost, and is taken from the price per lamp in the previous figure, cutting away and making good mouldings, &c., being extra.

Assuming the cost of wiring of an ordinary private house to be unity, then the price for other buildings, &c., compares roughly as follows:—

| | |
|---|---|
| Private houses ... ... ... ... ... | 1·00 |
| Textile factories ... ... ... ... | ·75 |
| Printing offices ... ... ... ... ... | ·80 |
| Engineering and machine works ... ... | ·90 |
| Breweries ... ... ... ... ... | ·92 |
| Paper mills ... ... ... ... ... | ·96 |
| Theatres and music halls ... ... ... | 1·00 |
| Hotels and restaurants ... ... ... | 1·10 |
| Dye works ... ... ... ... ... | 1·15 |

Cutting away and making good decorations, parquet floorings, and other special work should be done by builders and decorators skilled in such work.

With regard to the cables, it is just as well to inquire whether any of the situations in which lamps are to be placed

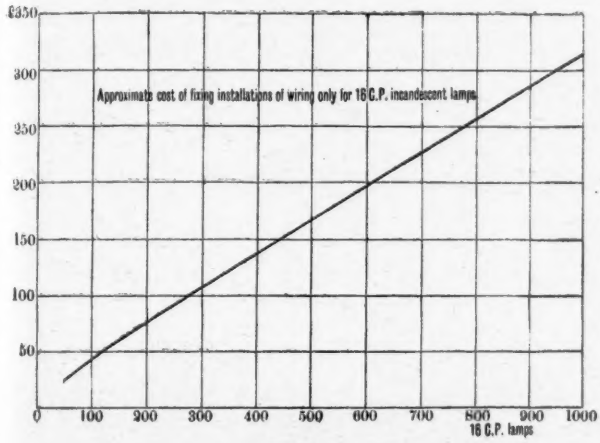



Fig. 7.

are wet. 600-megohm cable is generally employed, but in damp places special precautions must be taken. In estimating for large installations where there are several detached buildings, it is necessary to know beforehand from the proprietor whether he would like the wires carried overhead or underground. In the latter case lead-covered and armoured cable would have to be employed, and it is of course very much more expensive.

The actual cost of cable and casing can, of course, be ascertained by actually measuring along the route to be taken, but most estimates have to be made from rough sketch plans only. About 7s. per lamp will generally cover the wire and 1s. 6d. per lamp the white wood casing, but much depends on whether the lamps are grouped together. Grouping by means of electroliers, &c., reduces the price of the wire and casing and increases the price of the fitting. For ordinary plain electroliers the one will about balance the extra expense of the other. If the casing has to be painted allow 1s. per lamp or point extra. Circuits for heating and cooking appliances should be run independently.

The cost of foundations, mason, and carpenter's work in connection with the generating plant generally costs about 4 per cent. of the total price of the plant.

The cost of erecting the generating plant, including fixing the switchboard and the piping, if quite simple, is about 12 per cent. of the total cost of the plant.

In the above estimates nothing is allowed for spares, these are usually introduced in the form of extras, and may tot up to from 3 per cent. to 5 per cent. on the total contract price.

### Working Expenses and Maintenance.

Having dealt with the cost of the installation, there now only remains the question of working expenses and maintenance. Assume that a warehouse has an electric light installation of 200 16-c.p. incandescent lamps of 60 watts each, and that when the number of hours of the lamps burning are all averaged up together they equal, say, three hours per day for 300 days in the year. The total H.P. absorbed at the lamps will be

$$\frac{200 \times 60}{746} = 16 \text{ E.H.P.},$$

or allowing for 2½ per cent. loss in mains, 10 per cent. loss in dynamo, and 5 per cent loss in the belt; the B.H.P. of the engine will equal

$$\frac{16}{\cdot 975 \times \cdot 90 \times \cdot 95} = 19\tfrac{1}{4} \text{ B.H.P.}$$

Multiplying the number of hours by the B.H.P., we get the total number of B.H.P.-hours per annum at 17,400 B.H.P.-hours.

$$3 \times 300 \times 19\tfrac{1}{4} = 17{,}400 \text{ B.H.P.-hours.}$$

If now we multiply this by the pounds of coal per B.H.P.-hour which is consumed by the engine, we shall get the amount of coal consumed in the year, and this at 20s. or whatever the price may be a ton delivered in the stokehole, gives the cost of fuel consumed.

Maintenance expenses are made up of the following items:—

*Fuel.*—If a steam engine and boiler is used, allow 6½ lbs. of coal per B.H.P.-hour for a simple engine, and 4 lbs. of coal per B.H.P.-hour for a compound engine. In addition to this allow ½ lb. of coal per square foot of heating surface of boiler for as many working days a year as the boiler is running. The price of fuel varies with the locality; cartage and all other charges should be included.

*Oil, Waste, Water, and Stores.*—Take the total cost of these items at 20 per cent. of the total cost of the fuel. In certain cases the water would not cost anything, and if a filter was used, the oil could be used many times over.

*Attendance.*—For an installation up to 300 lamps, one man at, say, 35s. per week would be sufficient in this country. From 300 to 900 lamps, allow for one man at 40s., and an assistant at 20s.

*Renewals.*—It is usual to calculate that incandescent lamps require renewal after about 800 hours. Of course, some will give a good light for a longer period, but these are balanced by breakages, &c. The price of a 16 c.p. 110-volt lamp can be now taken at 9d. The lamp tops can be afterwards sold for the platinum.

*Repairs.*—This item should be taken at 2½ per cent. on the total capital cost of the installation.

*Depreciation.*—Taken at 5 per cent. on capital cost.

*Interest.*—Taken at 5 per cent. on capital cost.

### Notes on Arc Lamps.

For outdoor illumination about 1 c.p. per 10 square feet. The usual method is to place the arcs a certain number of yards apart, say 50, and 22 feet high. For indoor lighting allow 2½ c.p. per 10 square feet, the inverted arc is the best to use for indoor work.

The usual sizes for arc lamps are 750 c.p., 1,000 c.p.,

1,500 C.P. and 2,000 C.P. The first two can be used for the illumination of halls, stores, lofty warehouses and yards, whilst the last two are for the lighting of streets, railway yards, carriage drives, &c.

The price of one 1,000-C.P. arc lamp installed complete at, say, 100 yards from the dynamo would be about £7; a lamp-post would cost extra.

| | |
|---|---|
| If of wood ... ... ... ... ... | 15s. |
| Ordinary iron post ... ... ... ... | £3 |
| Lattice poles 50 feet as used in railway yards | £18 |
| Wall bracket ... ... ... ... ... | £2 |

The cost of carbons for a 1,000 C.P. lamp is $\frac{1}{4}$d. per lamp hour burnt.

In calculating the power required for ordinary open arc lamps working on a 110-volt circuit, it is necessary to note that when there is an odd number the odd lamp will require as much energy as two lamps, the extra amount of power being absorbed in the resistance in series with it. With enclosed long burning lamps which must of necessity be arranged singly across the 110-volt wires this does not apply.

## RETURN FEEDERS FOR ELECTRIC RAILWAYS.

(*Continued from page* 181.)

IV.—Graphic Determination of the Cross-Sections.

If only one end cable is used, the expression for the volume of copper, as we have seen above is:—

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{3\,K\,\Delta} + \frac{C\,L^2}{6\,K\,\Delta} = \frac{C\,L}{2\,K\,\Delta}\,L = \Sigma\,(s)\,L.$$

When there are an infinite number of cables, the second member of the expression vanishes, and

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{3\,K\,\Delta} = \frac{2}{3}\,\frac{C\,L}{2\,K\,\Delta} = \frac{2}{3}\,\Sigma\,(s)\,L.$$

The first volume can, therefore, be represented by the area of a rectangle whose sides are $\Sigma\,(s)$ and L; and the second by a parabola enclosed in the rectangle. The volume of a finite number of cables lies between these two areas.

This representation of the two limiting volumes furnishes us with an exceedingly simple graphic method of determining the section of each cable, whatever number of cables are used.

The process is as follows: the $\Sigma\,(s)$ is determined by the formula, and with this value, and L the length of the line, a rectangle is drawn (fig. 3). The parabola is drawn with the formula $y^2 = 2\frac{L\,K\,\Delta}{C}\,x$, which gives the final values of $x$ and $y$ as $\Sigma\,(s)$ and L respectively. Upon the length $L_1$ points are marked where the intermediate cables are connected. Let two be connected at 6 and 12 kilometres. From the point 6 a parallel is drawn to the axis X, cutting the line O R in the point N. If $N_1\,P_1$ is made equal to $P_1\,N_1$ then N $N_1$ represents the section of the first cable. Draw now, through the point $N_1$ a line $N_1$ M parallel to the line A E, and draw from the 12 km. point a line parallel to the axis X to cut the line $N_1$ M in M. Choose the point $M_1$ so that $M_1\,P_2$ is equal to M $P_2$; then M $M_1$ will represent the cross-section of the second cable. The remaining part of the line, S E, gives the cross-section of the end cable.

Before giving the proof of the correctness of this construction we shall show, by an example, that the cross-sections obtained agree with those obtained by the general formula.

If we designate the co-ordinates of the points of the parabola, $P_1\,P_2$ E by $x_1\,x_2\,x_3$ and $y_1\,y_2\,y_3$, then according to the construction

$$s_1 = 2\,x_1,$$
$$s_2 = 2\,(x_2 - s_1) = 2\,(x_2 - 2\,x_1),$$
$$s_3 = x_3 - (s_2 + s_1) = x_3 - 2\,x_2 + 2\,x_1.$$

The value of the ordinates, $y$, corresponding to the values of the abscissæ $x_1\,x_2\,x_3$ are $\frac{L}{3}$, $\frac{2}{3}$ L and $L_1$, and from the equation to the parabola we deduce

$$x_1 = \frac{1}{9}\,\frac{C\,L}{2\,K\,\Delta} \text{ and } s_1 = \frac{2}{9}\,\frac{C\,L}{2\,K\,\Delta},$$
$$x_2 = \frac{4}{9}\,\frac{C\,L}{2\,K\,\Delta} \qquad s_2 = \frac{4}{9}\,\frac{C\,L}{2\,K\,\Delta},$$
$$x_3 = \frac{C\,L}{2\,K\,\Delta} \qquad s_3 = \frac{3}{9}\,\frac{C\,L}{2\,K\,\Delta}.$$

From this, volumes come out

$$v_1 = \frac{2}{9}\,\frac{C\,L}{2\,K\,\Delta}\cdot\frac{L}{3},$$
$$v_2 = \frac{4}{9}\,\frac{C\,L}{2\,K\,\Delta}\,\frac{2\,L}{3},$$
$$v_3 = \frac{3}{9}\,\frac{C\,L}{2\,K\,\Delta}\,L;$$

adding these

$$\Sigma\,(v) = \frac{C\,L^2}{2\,K\,\Delta}\left\{\frac{2}{27} + \frac{8}{27} + \frac{9}{27}\right\} = \frac{C\,L^2}{2\,K\,\Delta}\cdot\frac{19}{27}.$$

This value can be split up into

$$\frac{C\,L^2}{3\,K\,\Delta} + \frac{C\,L^2}{6\cdot 3^2\,.\,K\,\Delta},$$

or in terms of the general formula, when $m = 2$,

$$\Sigma\,(v) = \frac{C\,L^2}{3\,K\,\Delta} + \frac{C\,L^2}{6\,(2+1)^2\,K\,\Delta}.$$

We see, from this, the values for the volume of the copper obtained from the diagram agree with those obtained from the general formula.

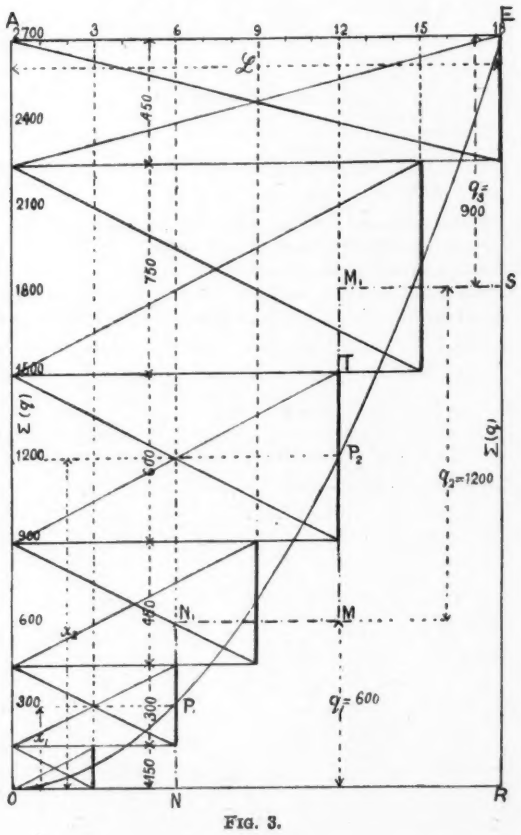



Fig. 3.

It now remains to show that the section obtained by the diagram for each separate cable is correct. Of course, with assumption of constant potential drop and current that has been made, the cross-sections are proportional to the lengths of the cables, so that if $l$, 2 $l$, 3 $l$ . . . . are the lengths of the cables, $s_2 = 2\,s_1$, $s_3 = 3\,s_1$ . . . . $s_r = r\,s_1$. Consider now the cross-section of the cable, of which the length is $r\,l$. As is evident from fig. 3, half the sum of the cross-sections of the $r$th and $(r-1)$th cables, is equal to the difference of the abscissæ $x_r$ and $x_{r-1}$, *i.e.*,

$$\tfrac{1}{2}\,(s_r + s_{r-1}) = x_r - x_{r-1}.$$

Since the cross-sections are proportional to the lengths,

$$s_{r-1} = s_r \frac{r-1}{r},$$

therefore $$\tfrac{1}{2}\left\{ s_r + s_r \frac{r-1}{r} \right\} = x_r - x_{r-1},$$

or $$\tfrac{1}{2} s_r \frac{2r-1}{r} = x_r - x_{r-1}.$$

Now according to the equation to the parabola,

$$x = \frac{y^2 C}{2 L K \Delta}.$$

Since for $x_r$, $$y = \frac{L}{m+1} r,$$

and for $x_{r-1}$, $$y = \frac{L}{m+1}(r-1),$$

$$x_r = \frac{L^2}{(m+1)^2} r^2 \times \frac{C}{2 L K \Delta}$$

and $$x_{r-1} = \frac{L}{(m+1)^2}(r-1)^2 \times \frac{C}{2 L K \Delta}.$$

These values, substituted in the above equation, give

$$\tfrac{1}{2} s_r \frac{2r-1}{r} = \frac{L C}{(m+1)^2 2 K \Delta}\{r^2 - (r-1)^2\},$$

or $$s_r \frac{2r-1}{r} = \frac{L C}{(m+1)^2 K \Delta}(2r-1),$$

therefore, $$s_r = \frac{C L}{(m+1)^2 K \Delta} r.$$

This expression is the desired cross-section. The current in the end cable is only half that in an intermediate cable, therefore the line representing its cross-section stops at the parabola (E, fig. 3).

In fig. 3 the construction for five intermediate cables and one end cable is also shown. The cross-sections obtained are 150, 300, 450, 600, 750 and 450 mm². The area of the crossed rectangles represent the copper volume of each cable.

It is evident from the graphic construction that it makes no difference to the total cross-section of the cables, where the cables are connected to the line. The cross-section of the end cable is (see above) $s_e = \frac{C L}{2 \Delta K (m+1)}$. It depends, with the given conditions of working only on the value of $(m+1)$, that is upon the current $\frac{C}{m+1}$; it makes no difference whether the sum of the other currents is taken by several or by one intermediate cable, if the connection points of the latter are chosen so as not to change the current in the end cable. If there are $m$ intermediate cables, the last cable connects to the line at a point $\frac{L}{m+1}$ from the end cable. Now, the expression for the cross-section of the end cable can be written

$$S_e = \frac{C L}{2 \Delta K (m+1)} = \frac{\Sigma(s)}{m+1}.$$

Therefore the cross-section of the end cable is proportional to its distance from the last intermediate cable.

If, for example, one intermediate cable is connected at 12 km., the length, $\Sigma(s) = 2{,}700$ mm², is to be divided in the ratio of 6 : 12, and the shorter length $2{,}700 \times \frac{6}{18} = 900$ is the cross-section of the end cable. The remaining 1,800 mm² of cross-section falls to the share of the single intermediate cable at 12 km., or to any given number of intermediate cables connected at equal intervals, whose sections may be determined by the graphic construction as already described. If, for example, cables were connected at 4 and 8 km., the section for these comes out 266 and 534 mm². Since 900 mm² fall to the share of the end cable, 1,000 mm² is left for the 12 km. cable as the construction shows.

*(To be continued.)*

## THE REPORT OF THE PACIFIC CABLE COMMITTEE.

*(Continued from page 184.)*

Sir W. H. Preece gives the average number of letters per word in trans-Atlantic traffic as 7·3; this figure was arrived at by actually counting the words in the body of every message for the Anglo-American Company which passed through several postal telegraph offices, for two hours during six days, and should therefore be a very useful figure; making allowance for spacing, the word is taken for sending purposes as consisting of eight letters, and the non-paying words are given as about 48 per cent., a percentage of loss which it appears would increase as the clerks grew tired. Mr. Lucas says that "70 letters per minute would give you on the section from Vancouver to Fanning Island something like four or five paying words per minute, not more." Assuming these to be words of eight letters, this means a "dead" traffic of about 50 per cent. Dr. Muirhead, after premising that he is calculating on the basis of the experience of the Eastern companies, according to whom he says "as much time is given to preamble, &c., as to messages," goes on as follows: "on the assumptions, (1) that only average operators are employed; (2) that the average length of code words is nine letters; (3) that half the time of transmission is occupied with preambles, calls, services, and other unpaid matter; and (4) that duplex automatic curb transmission is adopted, a cable 3,600 knots in length of a core weighing 500 lbs. copper and 320 lbs. gutta-percha per knot would earn eight paying words per minute. The same length of 552 copper and 368 gutta-percha core would earn nine paying words per minute." From the above we gather that as the core 500/320 will, according to a previous answer given by Dr. Muirhead, carry 140 letters per minute under conditions similar to those explained above, the non-paying words amount to about 50 per cent. of the traffic. It must be borne in mind here that Dr. Muirhead is not basing this figure on his own observations.

There is a considerable discrepancy between the figures given by the two groups of witnesses as representing the proportion of non-paying traffic; some of these are not expressly stated, and we have had to deduce them from various portions of the evidence, but those representing the Anglo-American Telegraph Company, the Commercial Company, the South American Cable Company, and the Indo-European Government Telegraph cables, all agree in giving the proportion of "dead" traffic transmitted as being between 10 and 16* per cent. of the total; whereas the Eastern Telegraph Company make this about 75 per cent., and the Post Office officials give about 48 per cent. at the lowest valuation. It is obvious that as far as estimating the "profit-earning" capacity of a cable is concerned, it is important that the line should be worked under the most economical system of management, and in the absence of fuller explanations we prefer to accept the figures given by the group of companies above mentioned; always bearing in mind that in the case of the Pacific cable, the messages in transit between England and Australia, which will undoubtedly form the bulk of the traffic, and which will pass through Canada, there will not be that necessity for the lengthy indications which, as Mr. Lamb points out, are used for purposes of International account, &c., on lines which pass through various foreign countries. Mr. Lamb expresses an opinion that every one of such indications would have to be sent on a Pacific cable, because the Australian Colonies are parties to the International Convention, but in question 2,255, this witness says, in reference to the creation of competition in charges between existing routes, "where States are concerned, the intention of the International Telegraph Convention is that one set of States shall not disregard the interests of another. In this case I think it might be shown that the Mother Country and the Australian Colonies—who are all parties to the International Convention—would be disregarding the interests

* In their report the Committee state that the non-paying traffic is given as 15 per cent. in the case of Mr. Carson, and 17 per cent. in the cases of Messrs. R. Kaye Gray and Finch, but an examination of the evidence will show that the figures which we have used more accurately represent the evidence given.

of India, which is also a separate member of the International Union."

In Mr. Ffinch's evidence we find the following in a letter from the Secretary of State for India:—"I am to enclose, for the information of Mr. Chamberlain, a statement showing the extent to which the Indian revenues are concerned in the existing lines; but, having regard to the considerations represented in your letter, Lord George Hamilton is not disposed to make this a ground of preliminary objection against any scheme for an alternative route to which Her Majesty's Government may attach commercial or strategic importance." This does away with the fear of any objection from India as an adherent to the Convention.

As regards the amount of traffic which would probably be directed over the Pacific cable, Sir Sandford Fleming has assumed this amount to be equal to half the existing traffic between Europe and Australasia; and this seems a very fair assumption, as, given equal rates over the Indian Ocean and the Pacific Ocean cables, and supposing both of these to be equally efficient, the Pacific cable has the advantage of landing in the vicinity of the business centres of Australia, the joint population of New Zealand, New South Wales, Queensland, and Victoria being 3,700,000, as against the 530,000 in Western Australia and South Australia, where the existing cables land, at Roebuck Bay and Port Darwin respectively. These latter landing places are connected to the first-named group of colonies by very long landlines, which do not give a satisfactory service. The land distance from the Port Darwin landing to Sydney is about 3,000 miles, while the length of landline from Roebuck Bay to Sydney is about 3,800 miles. For the above reasons, and also because the majority of the unrouted traffic will probably be sent *viâ* the Pacific, it appears to us that Sir Sandford Fleming has not been over sanguine in claiming 50 per cent. as the amount of traffic which will probably accrue to the Pacific cable. The total number of words transmitted between Australia and Europe in 1896 is given as 2,826,984. The representatives of the Eastern Extension Company assume that their line would retain all the West Australia and South Australia traffic, also one-half of that of Victoria and Tasmania, and one-quarter of the messages to and from New Zealand and New South Wales. We must say we cannot see on what foundation this reasoning is based; such a division seems an extremely hopeful one on the part of the company. Sir W. H. Preece goes into an interesting calculation, by which he shows that assuming a cable which can only transmit three (paying) words per minute, and which is only worked for 10 hours per day, owing to the clerks being "tired," and only 300 working days in the year, then such a cable will not carry more than 540,000 words in 12 months. As the particular cable referred to was calculated by Dr. Muirhead and given when working duplex 20 eight-letter words per minute, and as the evidence shows that 25 per cent. is a very liberal deduction to make for non-paying traffic, we get 15 words per minute instead of three, and by the simple process of doubling the 10 hours (and Sir W. H. Preece gives no good reason why this should not be done), we get 20 out of the 24; this, at the narrow estimate of 300 days to the year, gives us 5,400,000 words per annum. Sir W. H. Preece seeks to reduce the possible working day of this cable to 10 hours by such reasoning as the following, in reply to Lord Selborne:—

1,370. I will assume your three words per minute, but I want to go very closely into this question of 10 hours. Ten hours, you tell us, is by practical experience what these telegraph cables work at?—It was my practical experience of the work of telegraphs generally. I want particularly to consider this part of the business as absolute estimate, and I want to have it confirmed or upset,

1,371. All business that comes to the telegraphs over which you have control can be cleared in 10 hours' working?—Yes, certainly. That is much more than our telegraph experience in England. It will be more like four or five hours.

1,372. Then supposing the work to be double, would it not be merely a question of staff to work 20 hours a day?—It would be a question of business more than staff, because you cannot attract it.

1,373. I said suppose the business to be doubled, could not that business be worked off on the same line in 20 hours by merely increasing the staff?—No, because I have assumed that the high pressure of course with this work cannot be maintained during the 24 hours, even with a fresh staff of clerks.

1,374. Why not?—For the reason that I gave, that clerks tire, and you cannot maintain high pressure for a long period.

Mr. Murray.

1,375. And you cannot get the work at the right time?—That is another element. That is where the work does not come; it only comes in driblets, as a matter of fact.

Chairman.

1,376. But supposing one office, we will say going to America, suppose on some great occasion an immense amount of work comes in during the day, that would be worked off during the night?—Of course.

1,377. And customers do not complain, as a general rule, because their telegrams may be delayed an hour or two?—No.

1,378. Is it your experience that they do?—I beg your pardon.

1,379. Is it your experience that if a telegram is handed in for Australia, we will say to-day, is the public fairly satisfied if they get an answer within a certain number of hours?—I think so. I think very well satisfied if they get an answer in 24 hours.

1,380. In 24 hours?—Yes.

1,381. And therefore, at a stress, arrears could be worked off during the night?—Yes.

1,382. That being so, I do not understand why you are of opinion that we are obliged to reckon the working of any cable at 10 hours as the only time at our disposal?—Because these calculations are based on the assumption that our maximum speed is obtained under great pressure, and that this great pressure cannot be maintained for reasons that I have given. You must not take a maximum speed as your working speed, but you must take a mean speed. That has varied very much by the companies I gave you.

1,383. But you cannot be accused of taking a maximum speed. You have, by a process which has interested the Committee very much, reduced the working speed down to three words a minute?—Yes.

1,384. That you do not consider a maximum speed?—No; I call that the ordinary working speed.

1,385. The ordinary working speed. Then why cannot that speed be maintained for as many hours over the line as you can find staff to work it?—So you could if you had the work.

## CORRESPONDENCE.

### The Direct Reading Ohmmeter.

I note in your issue of July 14th, that Mr. N. C. Woodfin, of Patterson, Cooper & Co., recites his experience with the direct reading ohmmeter.

With reference to what he says concerning the use of the instrument in a noisy place, I would say that I have been able to secure quite accurate results by noting the places on either side of the silence point where the noise begins and bisecting the distance between them. The noisier the place the wider this gap will be, but with care and a little practice I have been able to secure almost as accurate results in moderately noisy places as in silent ones. I have also found it necessary to keep the dry batteries in the bridge in good order, and when the click on the instrument becomes faint it is best to renew the batteries, which can be done at a cost not exceeding 3s. With these precautions well in mind I have had no difficulty in attaining the claims of the makers of the instrument.

It is perhaps well to state that in the measurement of very high and very low resistances the accuracies of ½ per cent. are exceedingly difficult if not impossible to attain with an instrument of the Wheatstone bridge type. With high resistances, such as insulation resistances and the like, I find that the insulation resistance seems to be proportional to the very variable and erratic function of the temperature and of the voltage applied, and the possibilities of measuring such an elusive resistance with anything like accuracy are very remote. This, however, is not the fault of the instrument, for it is doubtless theoretically correct at those points. The scale is laid out according to a mathematical law, and there is no reason why this should not be so.

With reference to the measurement of low resistances, that is to say, exceedingly low resistance such as armature coils or armature resistances, I would say that I find that the difficulty of making connections of negligible resistance, limits the accuracy of the instrument. In measuring the resistance of armatures it is difficult to obtain connections to the resistance to be measured of lower resistance than the armature itself. This, again, is no fault of the instrument, but rather due to the fact that the instrument is out of its class. I have always obtained my best results in measuring very high resistances with the aid of a voltmeter and a substantial voltage of 110 to 500 volts, and the low resistances I find are best measured by a fall of potential method. For the measurement of intermediate resistance I have found the ohmmeter exceedingly accurate and satisfactory.

With regard to portability I would say that I have a leather carrying case with a strap, which seems to answer every requirement, and also prevents the box from being marred.

Geo. T. Hanchett.

### The Pacific Cable.

It has been brought to my knowledge that you have been defending me against the chairman of the Eastern Telegraph Company in respect of strictures by him on an opinion incidentally expressed by me as to the vulnerability of our great telegraph routes in time of war. I did not answer these remarks because the matter was, as I say, only an incidental one in my speech on the deputation to the Chancellor of the Exchequer, and I was, in fact, only engaged in replying to some observations in the other sense which had been previously made by Lord Tweeddale. The subject is one which will sooner or later come up for debate in Parliament, and, if necessary, I shall be able there to express my views. My main statement was that all our communications with the East, and, indeed, with our leading strategical points generally, are within the control of possible enemies, in Russia, Turkey, or Persia, or else touch at Lisbon. In many cases they both touch at Lisbon, and also pass through one of the three countries named. Lord Tweeddale appeared, in his reply, to throw doubt upon the accuracy of this statement, and to suggest that he knew of some direct British route to Gibraltar at least. But no such route is marked on the latest cable maps.

Charles W. Dilke.

### Electrolytic Extraction of Zinc.

In examining the papers which have recently reached me, I find two numbers of the Electrical Review, the one dated July 7th, and the other July 14th last; at the pages 36 and 37 of the first number and at the page 43 of the second, I noticed two articles concerning the electrolytic extraction of zinc (by the Hoepfner and the Cowper-Coles processes).

Both methods seem to be characterised by the application of the rotary cathode, claimed by me in my English patent dated April 1st, 1892, No. 14,892. Everybody may look into the same patent at the Patent Office. The United States patent which has been granted to me for the same object on September 24th, 1892, under No. 446,775, may also be looked at.

I wished to draw the attention of the readers of the Electrical Review to the fact that up to the present date no one has been able to oppose any anteriority whatever to my rotary cathodes, not even the patentamt of Berlin.

As you publish the descriptions of processes in which rotary cathodes are used, I rely upon your impartiality and your courtesy to insert the present letter.

D. Tommasi.

Paris, *August 1st*, 1899.

### Re The Patent Renewable Glow Lamp.

Anent your remarks on above in last week's issue of your enterprising journal, will you permit an old reader, and a friend of the patentees, and one cognisant of the incomparable advantages of which the above lamp is alone capable, to clear the ground of certain misapprehensions in this relation? First let me say that, had I space and your permission, to give in detail the unique capacity of this lamp to prolong its utility, at such a small outlay of material, time, labour and money, and to explain *how* through the continuous interchangeability of its filaments the thorough utilisation of *all* its material is effected to the utmost extent, the commercial value, and complete public service claimed for this innovation by those of the highest repute and honour as practical experts, who have submitted it to the most crucial tests, would be so manifest that, even your hypercritical correspondent, "Experientia Docet," would admit the justice of the claim that this lamp will not only be the salvation of the enclosed globe, but supplies the long felt public want among consumers of the current, by revolutionising the present system of lamp replacements, and doing away with the practice of having *new lamps, and paying full prices for same.*

And so far from efficiency being sacrificed for cheapness, it will be found, by comparison, that it is the highest ever recorded so soon as the lamp is on the market.

Surely it must be a great commercial achievement in any industry *to reduce maximum waste of material and labour.*

As instanced in the glow lamp industry at present, incomputable and broadcast waste of glow lamps takes place the moment the lamps at present in use reach the end of their first and only life.

True, many have tried to solve the problem of interchangeability of filaments, even Westinghouse with his glass stopper, &c. How impracticable these devices were doubtless you are aware, sir, but none hit upon the simple design of a tubular neck and expeditious method of exchanging filaments devised by C. Howard.

Depend upon it, sir, if the advantages claimed were not genuine, and had not been actually demonstrated, neither Sir W. H. Preece's nor Major Cardew's name would have been on the front page of the prospectus to bear testimony to the same. Neither would Mr. Jacob Atherton, of the British Insulated Wire Company (a most successful company), have been identified with it unless it was the inimitable lamp the inventor asserts it to be. The economy claimed will, on comparison, be found to be actual and enduring, and be assured that it has come to stay, despite "Experientia Docet," whose friends will find shortly that their large stock of lamps, &c., &c., are obsolete and unsaleable. Without attempting to answer his assertions, let me say that all his objections have no relation, or bearing, to the above lamp, and prove conclusively "how little" he knows of the invention.

In conclusion, let me add that (1) the company only claim to renew their own lamps, it's impossible to renew any other. (2) The filaments are of that peculiar kind that the bulbs are free from deposited carbon. (3) The glass, too, is unique, and manner of opening and fusing so practicable that breakages will be very rare. (4) The detachable socket has withstood the most severe tests, and is a perfect success, and will admit of being used perpetually. (5) In all other lamp factories there is a certain loss of between 25 and 30 per cent. on lamps made, through some non-glowing defect, broken filaments, &c., in the manufacture of this lamp *such loss will be unknown*, as the least, or most serious, defect can be at once rectified by opening at neck where renewal of filaments takes place. That the economising and prolonging utility of this lamp is without parallel in this electrical age, goes without saying, and consumers will ere long have the opportunity of verifying.

I could add to what I've said, but for fear of incurring your displeasure, Mr. Editor. Thanking you in anticipation of your inserting this, and apologising for its length, I remain faithfully yours,

Charles Clifford.

[This letter leaves us little the wiser, but so that we may be further enlightened our "space and permission" are both at the writer's disposal.—Eds. Elec. Rev.]

### Gas Engines v. Electro-Motors.

Why, in your issue of 28th ult., do you discredit the 20 cubic feet per B.H.P. per hour gas consumption of the Stockport gas engine, while giving prominence (and credence) to the 16·78 cubic feet per B.H.P. per hour gas consumption of the Westinghouse engine?

Of course, your notice does not state the consumption of the Westinghouse engine in terms of the B.H.P., but that is what 1,000 cubic feet giving 40 KW.-hours means at 90 per cent. dynamo efficiency.

Judging from my own experience of gas engines, neither result is in any way extraordinary. On one of Messrs. Crossley Bros'. new designs I obtained a B.H.P. for 13·5 cubic feet of 700 B.T.U. gas per hour—a result which, at the time, I considered a record, and which, I believe, can be repeated at any time. As this gives a thermal efficiency of 27·1 per cent., you will appreciate my belief in the record; but, unfortunately, I found in the *Railroad Gazette* particulars of a test made on a 6 × 11 two-cylinder "Pittsburg" (*i.e.*, Westinghouse) engine that eclipses my result completely. This engine gave 9·1 B.H.P. for a consumption of 165 cubic feet of 434·3 B.T.U. gas per hour. The consumption per B.H.P. is thus 18·13 cubic feet per hour, but owing to the low calorific value of the gas, this gives the extraordinary thermal efficiency of 32·3 per cent. From this it must be considered that the Westinghouse

engine is 16·6 per cent. more efficient than the Crossley engine. I will not attempt to account for this extraordinary superiority of the Westinghouse engine, but I may point out that it is in no way due to the fact that the Westinghouse engine governs on a reduced compression charge (*i.e.*, by throttling), while the Crossley engine governs by cutting out charges, and maintains a constant compression, for both engines were then working at full load igniting every time. In conclusion, I would remark that the Westinghouse engine is "not" the only engine that governs by throttling its charges. There are large numbers of engines working in this country with stepped air and gas cams under control of the governor, which operate exactly in the same way as the Westinghouse engine; but these, on the whole, have not been found to compare at all favourably with engines governed on the "hit-and-miss" principle. The superior economy of the engines governed on the latter principle is such as to admit of the slight sacrifice of mechanical efficiency due to the use of the heavier fly-wheels necessary to give equal steadiness of running in both types, and still be superior in thermal efficiency.

Jas. Dunlop.

Gorton, Manchester.
*August 4th*, 1899.

## BUSINESS NOTICES, &c.

### Electrical Wares Exported.

| Week ending Aug 9th, 1898 | | Week ending Aug. 8th, 1899. | |
|---|---|---|---|
| Adelaide .. .. .. | Value £146 | Adelaide .. .. | Value £349 |
| Alexandria .. .. .. .. | 58 | Aden. Teleg. mat. .. .. | 45 |
| „ Teleg. mat. .. | 20 | Amsterdam .. .. .. .. | 100 |
| Amsterdam .. .. .. .. | 205 | „ Teleg. mat. .. | 245 |
| Antwerp .. .. .. .. | 329 | Bangkok .. .. .. .. | 86 |
| Auckland .. .. .. .. | 166 | Boca .. .. .. .. .. | 284 |
| Bergen .. .. .. .. | 7,518 | Bombay .. .. .. .. | 107 |
| Bombay .. .. .. .. | 200 | Boulogne .. .. .. .. | 90 |
| Bologne .. .. .. | 82 | „ Teleg. apparatus .. | 2,900 |
| Bremen. Teleg. mat. .. .. | 150 | Brisbane. 50 tons iron teleg. poles, value not declared. | |
| „ Sub. cable .. .. | 180 | Buenos Ayres .. .. .. | 524 |
| Buenos Ayres .. .. .. | 6,855 | „ Teleg. wire .. | 161 |
| Calcutta .. .. .. .. | 2·3 | Calcutta .. .. .. .. | 929 |
| Cape Town .. .. .. .. | 602 | „ Electric launch .. | 88 |
| Copenhagen .. .. .. | 19 | Cape Town .. .. .. .. | 2 4 |
| Durban .. .. .. .. | 2,838 | „ Teleg. scores .. | 16 |
| East London .. .. .. | 81 | Colombo .. .. .. .. | 19 |
| Fremantle .. .. .. .. | 30 | Copenhagen .. .. .. | 14 |
| Hamburg .. .. .. .. | 210 | Delagoa Bay .. .. .. | 28 |
| Helsingfors .. .. .. .. | 29 | Durban .. .. .. | 10 |
| Kolding. Teleg. cable .. .. | 252 | „ Teleg. mat. .. .. | 31 |
| Liban .. .. .. .. .. | 54 | „ Teleph. mat. .. .. | 44 |
| Lyttleton .. .. .. .. | 47 | East London .. .. .. | 606 |
| Madras .. .. .. .. | 86 | Flushing .. .. .. .. | 25 |
| Marseilles .. .. .. .. | 50 | Genoa. Teleg. mat. .. .. | 35 |
| Melbourne .. .. .. .. | 40 | Gibraltar .. .. .. .. | 61 |
| „ Teleg. mat. .. | 410 | Halifax (N.S.). Teleg. cable .. | 555 |
| Montreal .. .. .. .. | 25 | Hamburg. Teleg. mat. .. .. | 170 |
| Odessa .. .. .. .. | 190 | Hong Kong .. .. .. .. | 285 |
| Penang .. .. .. .. | 25 | Jersey and Guernsey .. .. | 50 |
| Port Elizabeth .. .. .. | 819 | Launceston .. .. .. .. | 140 |
| Rangoon .. .. .. .. | 55 | Malta .. .. .. .. .. | 30 |
| Rockhampton .. .. .. | 174 | Melbourne .. .. .. .. | 103 |
| St. Petersburg .. .. .. | 14 | „ Teleg. mat. .. | 130 |
| „ Elec. launch .. | 1,300 | Ostend .. .. .. .. .. | 65 |
| Shanghai .. .. .. .. | 260 | Paris .. .. .. .. .. | 348 |
| Stockholm. Teleg. wire .. | 72 | Penang .. .. .. .. | 582 |
| Sydney .. .. .. .. | 680 | Perth .. .. .. .. | 29 |
| „ Teleg. mat. .. .. | 90 | „ Elec. tram machinery .. | 598 |
| Townsville. Teleg. mat. .. | 125 | Port Elizabeth .. .. .. | 26 |
| Wellington .. .. .. .. | 37 | „ Teleg. mat. .. | 228 |
| Yokohama .. .. .. .. | 27 | Port Said .. .. .. .. | 101 |
| „ Elec. cable .. .. | 480 | Rio Janeiro .. .. .. | 166 |
| | | Rosario. Teleg. wire .. .. | 17 |
| | | Rouen .. .. .. .. | 160 |
| | | Santos .. .. .. .. | 132 |
| | | Singapore. Teleg. cable .. | 42,000 |
| | | St. Petersburg. Teleg. wire .. | 88 |
| | | Sydney .. .. .. .. | 2,113 |
| | | „ Teleg. mat. .. .. | 844 |
| Total .. | £24,711 | Total .. | £55,986 |

### Foreign Goods Transhipped.

Batavia. Teleg. mat. .. Value £11

**Asbestos.**—The Admiralty contract for asbestos goods for the ensuing 12 months has again been awarded to the United Asbestos Company, Limited. This is the 14th year in which the company have been awarded important contracts by the Lords of the Admiralty.

**Bankruptcy Proceedings.**—The public examination of Alec Gavin Inrig, electrical engineer, 44 and 46, White Post Lane, Victoria Park, trading as the Globe Electrical Company, was held last week at the London Bankruptcy Court. The debtor has filed accounts showing liabilities £4,514 3s. 5d., against assets £330. In the course of his evidence the debtor stated that he came over from Antwerp in September, 1895, with a capital of £1,000, and started the above business. Four months later he was joined by a Mr. Chester, and they converted the business into a company styled Inrig and Chester, Limited, with a capital of £2,000. As vendor witness received £500 in fully paid shares, and he acted as joint managing director at a salary of £200 per annum, until the company went into liquidation at the end of 1896. The petitioning creditors next purchased the concern from the Official Receiver, and agreed to sell it to witness under a hiring agreement, but nothing further was done, and he managed it on their behalf at a salary until last November, when they refused to make any further advances. He subsequently carried on the business upon his own account until they (the petitioning creditors) brought him to the court early in June. To the action of those creditors, witness entirely attributed his failure. The examination was ordered to be concluded.

The examination in bankruptcy of John Lumsden Sloan, as sole partner of the firm of Wilks, Sloan & Co., electrical and consulting engineers, 112, Bath Street, took place in Glasgow on 7th inst., before Sheriff Balfour. In reply to Mr. George S. Robb, for creditors, bankrupt stated that he was interested in the reversion of the estate of Sir James Lumsden. In January a loan of £300 was obtained from a firm of money-lenders in Edinburgh, and he and Mr. Wilks and the cautioner signed a bill for £450. At this time he was drawing nothing from the business. The bulk of the loan was handed to Mr. Wilks, who was being pressed, to cover his private liabilities, and between £10 and £20 went into the business. A loan of £300, entirely for Mr. Wilks' benefit, was got from bankrupt's brother, who was to have a percentage on the money, and to have the option of becoming a partner at any time within three years. Before this Mr. Wilks had overdrawn his interest in the firm to a considerable extent, and any sum that went into the firm was to repay what he had overdrawn. Bankrupt put £250 into the business, and his loans to the firm and Mr. Wilks amounted to £750. The examination was adjourned.

**Catalogues, Lists, &c.**—From the Prentiss Clock Improvement Company, of New York City, we have received a pamphlet describing their improvements in long-running clocks and automatic perpetual calendars, also their synchronising and electrical controlling devices.

Messrs. Nalder, Brothers & Co., of Westminster, have issued a new edition of their catalogue of scientific instruments, in which they give capital illustrations, and neatly arranged data of their various instruments for electrical testing, also for engineering, mathematical, optical and other purposes. The opening page has a reproduction from a Röntgen photograph of the N.C.S. four-coil Kelvin galvanometer, showing the internal arrangements and connections. The class of apparatus made by Nalders is so well known that it is quite unnecessary to detail here the numerous instruments which find a place in this catalogue, which is a credit to compiler, illustrator and printer.

A new issue of the Concentric Wiring catalogue of Messrs. J. D. F. Andrews & Co., Limited, is to hand. It shows many new appliances and improvements.

A second edition of the Brush Electrical Engineering Company's Universal Engine Book has lately been brought out, giving some excellent sectional and general illustrations of the engine and parts, and describing the chief features.

From the Taper-Sleeve Pulley Works, of Erie, Pennsylvania, we have received an illustrated list of their solid-web, iron-centre, hard-wood dynamo, motor and generator pulleys, with copies of testimonials, code, &c.

The Western Telephone Construction Company, of Chicago, sends a copy of its catalogue of switchboards and apparatus required in connection with telephone exchange systems. Views are given of the various departments at the works, also of exchanges fitted with the company's manufactures, and there are also a number of illustrations of the apparatus described.

An incandescent lamp list, printed in English, French, and German, comes to hand from Mr. Paul Goldschmidt, of Featherstone Buildings, W.C. It contains particulars of the manufactures of Messrs. P. & M. Herre, of Berlin, who are specialists in small and fancy lamps. We understand that the factory equipment at Berlin is quite up to date, and includes the newest and best air pumps which are worked by motor. The list before us contains details regarding a large variety of fancy lamps of all designs, shapes, and sizes; also holders, switches, brackets, Geissler tubes, Crookes tubes, Ruhmkorff coils, &c.

The Electrical Company, Limited, has issued a new price list of carbons for "Luna" arc lamps.

**Change of Address.**—Mr. E. O. Sachs has moved his general and private offices from No. 11 to No. 3, Waterloo Place, Pall Mall, S.W.

**Copper.**—The *Financial News* says that some of the strength has departed from the statistical position of copper; for Messrs. Merton's figures show that the visible stock at the end of July had risen to 33,019 tons, compared with 28,515 tons a fortnight earlier, and 29,009 tons a month ago. Supplies were larger in July than for several months, and consumption has been checked—whether temporarily or not it would be difficult to say; for the jump from deliveries of 16,074 tons in May to 19,077 tons in June and the fall to 16,327 tons in July show an irregularity that puts generalisation at a discount. The supplies were 20,342 tons against 17,925 tons in June, and that in spite of a reduction of 4,100 tons in the arrivals from North America. "O her countries," which represent a variable quantity in the supplies, and cover all the copper-producing countries save North America, the Peninsula, Australia, and Chili, sent 6,767 tons in July, against 2,126 tons in June, and shipments from Chili were nearly 2,000 tons greater.

**Coal Cutting.**—Mr. E. W. Parker, of the United States Geological Survey, gives the following data with regard to the progress of mechanical coal cutters in America:—

| Year. | No. of machines at work. | Tonnage mined by machinery. | Average prices at mines. |
|---|---|---|---|
| 1891 | 545 | 6,211,730 | 4s. 10d. |
| 1895 | 1,446 | 22,649,220 | 3s. 4d. |

A breast cutting chain machine, such as is used very largely in the States, is officially stated to have undercut 1,700 square feet in 9½ hours, or 7½ minutes to each cut 6 feet deep and 44 inches wide, including the moving and setting of the machine.

**Messrs. D. Bruce Peebles & Co.**—We hear that this firm has secured the following municipal contracts:—Barrow-in-Furness, steam dynamo and accessories, total value of contract, £3,154; Southampton Corporation, balancers and boosters (section A), amount of contract, £2,070; Warrington Corporation, steam dynamos, Willans engines, total amount of contract, £6,788.

**The Lancashire Dynamo and Motor Company, Limited.**—As announced a fortnight ago, we have received a catalogue from the Lancashire Dynamo and Motor Company who are building a large works in Trafford Park, Manchester. This company was registered on April 11th, with a capital of £100,000 privately subscribed. The general manager is Mr. A. P. Wood, who, until recently, was an engineer with Messrs. Mather & Platt, Limited, in whose employ he had a considerable amount of experience both in this country and abroad. The company will manufacture continuous current and polyphase generators up to 3,000 H.P. in size, tramway motors, rotary converters, balancers, boosters, enclosed motors, &c. The latter, up to 50 H.P. in size, will be manufactured to stock on the interchangeable plan, all parts being sent to the stores to be tested on the measuring machines, and afterwards assembled as required. This system ensures uniformity in the various parts, so that should any breakage occur, the defective portion can be sent on receipt of a wire, and will *fit* into its place. These motors have been specially designed to meet the demand for a first-class reliable machine. They are especially suitable for working in damp and dirty places, and can be secured in almost any position. The motor can be readily fixed on the floor or the ceiling as required; in the latter case the end bearings are simply turned round, so that the oil wells are below. They may be used in oil mills, cotton mills, flour mills, dye houses, coal mines, iron foundries, shipbuilding yards (out in the open), and for cranes and hoists of all descriptions, &c. The armatures are slot drum wound of the straight cut type, each coil being separately wound on a former and taped up before being fixed in position on the armature. The windings at the back are protected by a brass shield, so as to effectually exclude oil or dirt. The commutator bars are of hard drawn copper insulated with specially selected mica. The bearings are of the swivel self-oiling type, each fitted with two oil rings. Special attention has been given to the design, so that oil cannot travel inside to the armature. The brushes are of carbon, and run sparklessly at all loads without being moved. The magnets are of cast-steel with laminated pole pieces to reduce eddy currents. The windings are former-wound and taped, dipped in insulating composition and baked. The machine tools and labour-saving devices, which will be all electrically driven, are the best that can be purchased, and the arrangement of the same will be such that work of the highest class can be expeditiously, accurately, and economically turned out. The works will be ready and completely equipped in six months' time, the contractors for the various portions being under a heavy penalty to complete in this period. Owing to the large number of orders on the books, it has been found necessary to commence manufacture in temporary works. The company's offices are located in Corn Exchange Buildings, Fennel Street, Manchester, pending the completion of the more commodious premises in Trafford Park.

Lancashire Dynamo and Motor Company's Motor.

**Easton, Anderson & Goolden, Limited v. New Brighton, &c., Tower Company, Limited.**—In the High Court last week this case came on for hearing. The plaintiffs claimed £4,794 for supplying electric lifts and a pump for the New Brighton Tower, already described in the Electrical Review. According to a report of the case in the *Times*, defendants admitted the greater part of the claim, subject to a counterclaim by them for £5,264 as damages for delay in completing the machinery which plaintiffs had contracted to erect. The case occupied the whole of the 3rd inst., and on the 4th a settlement was arrived at, in accordance with the terms of which the jury returned a verdict for the plaintiffs for the amount claimed; and they also gave a verdict for the defendants on the counterclaim for £600.

**Electric Construction Works.**—The directors of the Electric Construction Company, Limited, have just commenced extensive and important additions to their works at Bushbury, near Wolverhampton.

**Electric Light Fitting.**—The Edison & Swan United Electric Light Company send us a pamphlet respecting a new automatic wind-up apparatus (Killingworth Hedges' patent), which they

have just brought out. It is claimed to meet the general demand for a simple and reliable method of raising or lowering lamps suspended by flexible cord, so that, according to the requirement, the light may be brought to any desired position, and to bear upon any particular object. This facile movement is obtained without the use of "counterweights" or the arrangement of lengths of flexible cord. It is also well adapted for use with table and floor standards. The winding gear consists of a porcelain drum, on the ends of which are mounted the brass terminal plates to which the flexible cord is connected The drum is used in connection with and revolves centrally on a porcelain base, the latter being provided with terminals to which the leading-in wires are brought and which form the supports for the drum when connected with the terminal plates fixed on its ends. The flexible wire is wound up on the drum by means of a spring, and is controlled automatically by a small stop or peg fixed on one end of the drum and caught by means of a small ratchet wheel. When the flexible cord is withdrawn from the fitting to the desired length, all that is necessary is to allow the same to slowly and gently slide back with the guidance of the hand, when it will be found that the ratchet wheel has caught the peg or stop, thus preventing the drum from winding further. The same operation is repeated when a further length of flexible cord is required to be withdrawn. When desired to wind up the flexible wire a short pull of the flexible releases the peg or stop from the ratchet wheel, when it will be found the cord will fly back and re-wind itself round the drum. This form of wind-up can also conveniently be used in connection with hand lamps or similar portable fittings, as the fitting can be hung by the side of the wind-up apparatus when not in use, taking up little space and doing away with the necessity of a loose coil of flexible wire, which is invariably in the way.

**The Electric Welding Company, Limited.**—In the Chancery Division of the High Court of Justice on Friday (August 4th) Mr. Farwell, Q.C., said he had a motion to rectify the register of this company, but there was a possibility that the case would be settled, and he therefore asked that the motion should be allowed to stand over generally, with liberty to restore it upon application. Mr. Justice Byrne assented.

**Fan Motors.**—The Stewart Electrical Syndicate, Limited, send us a price list of the "Hurricane" fan motors (direct current) for which it has just been appointed sole agents in the United Kingdom. No extravagant claims are made for high efficiency, but it is being put on the market as a thoroughly good and reliable piece of apparatus, cheap, strong, and simple. The fan and motor rest on a universal ball joint, which is controlled by a screw sufficiently large to be conveniently operated by hand. The simplicity of this device permits the fan to be easily directed toward any point where it is most desirable at the time to throw the breeze.

**Fire.**—We are glad to learn that the fire at Henley's Telegraph Works was limited to the submarine cable department, and will not cause more than a week or two's delay in the execution of work of that particular class. The company are to be congratulated upon the efficiency with which they have organised their workmen to deal with fires either by night or day. The fire in question occurred late on Saturday night, and it was mainly due to the promptitude with which the workmen brought the hydrants and pumps to play, that the scope of the fire was limited to the one shop, and the work of the Fire Brigade in finally extinguishing the flames was thus rendered considerably easier.

**High Speed Engines.**—Messrs. Reavell & Co., Limited, of Ipswich, send particulars of their high speed enclosed constant thrust compound engines (Scott's patent). In the front of the list is an illustration of one of their two-crank engines coupled to a Crompton dynamo at the Islington Vestry electricity works. Messrs. Reavell have recently erected extensive and well-equipped works for the construction of these engines which are made in standard sizes, single and two-crank, and also as a three-crank engine. They are claimed to be specially suitable for direct coupling to dynamos, for electric lighting, traction, and other electric power purposes. We understand that a good number of these engines are now running in public and private installations. Instead of employing two cylinders as in an ordinary compound engine, the feature of the Scott engine is that the first stage of expansion takes place on the top of the piston, and the second stage on the bottom of the piston in one cylinder. Facilities are afforded at the works for the complete testing of the engines with purchaser's dynamos, at full load. The list before us gives a general description accompanied by an explanatory illustration of a single-crank engine. We do not doubt that Messrs. Reavell will be pleased to send a copy of the pamphlet to all inquirers.

**Holiday Tours.**—Those of our readers with whom the holidays are among joys yet to come, are recommended to peruse an interesting little pamphlet issued by the Great Eastern Railway, which gives views of some charming scenery in the Thuringian Mountains, and the Harz, including the sacred spots which once knew the tread of the celebrated Luther, and where some of his relics are yet to be found.

The L. B. & S. C. Railway is also circulating a very attractive "South Coast Quarterly," in which are illustrated some of the best coast line and "cross country" resorts within the area of that railway's service, where one may while away the idle hours of the holiday vacation.

**Liquidations, Dissolutions, &c.**—A meeting of the Improved Incandescent Electric Lamp (Foreign Patents) Syndicate, is to be held at 20, Jewry Street, E.C., on Saturday, September 9th, to hear an account of the winding-up from the liquidator, Mr. R. Ballard.

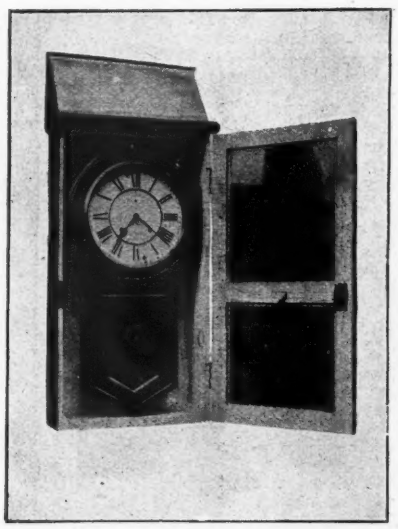
On Wednesday the petition filed by the Electric Construction Company for winding up the Madras Electric Tramways, was heard in London, and was ordered to stand over until the first petition day in November. If nothing has been done in the meantime, a compulsory order will be made.

**New Electrical Works.**—It is stated in the *Manchester Courier* that Messrs. Mather & Platt, Limited, the well-known electrical engineers of Salford, have taken over 40 acres of land near the canal and railway at Agecroft, in the township of Pendlebury, for the purpose of erecting modern workshops to meet the increasing demand for their various specialities in electrical plant. The proposed new works are situated near the Agecroft Collieries.

**Personal.**—It is stated in an American contemporary that Col. J. C. Bonner has left Toledo for England, in the interests of his rail waggon, a number of which have already been shipped to the Isle of Man. This order is considered to give the waggon a foothold abroad, and Mr. Bonner intends to see that they are placed in good working order and given a fair trial. Our contemporary adds:—"An effort is also being made to establish the waggons on an electric line in Birmingham, and this matter will take Col. Bonner to that city."

**Smoke Nuisance.**—The London County Council, it is announced, is to take action in regard to the smoke nuisance in London by taking steps for enforcing Section 114 of the Railway Clauses Consolidation Act, 1845, which requires that every locomotive shall be constructed to consume its own smoke, and Section 19 of the Regulation of Railways Act, 1868, which provides that if a locomotive is constructed to consume its own smoke, but fails to do so as far as practicable at the time charged in the complaint, the railway company owning such locomotive shall be deemed guilty of an offence against the section first named.

**Time Recording Clock.**—Mr. F. J. Borland, of Leeds, is now putting on the market a time recording clock to supply the evident need for a cheap form of apparatus for checking in workmen. The time checks are simply dropped through a funnel which delivers them into compartments of a receiver, the position of which is varied



by gearing connected with the works of the clock. An electrical attachment to ring a warning bell can also be attached when required. The whole arrangement is simple, and as long as the clock is going, cannot fail to act. The price is extremely moderate.

**Trade Announcements.**—We are informed that Mr. H. Binko, late managing director of Binko, Ridsdale & Co., Limited, has resumed his old established business as electrical engineer and manufacturer, at 34, Leadenhall Street, E.C., under the former style of H. Binko & Co.

Messrs. H. W. Sambidge & Son, of Birmingham, manufacturers of electric light fittings in brass and wrought-iron, have opened London showrooms at 19, Farringdon Avenue, E.C. We have received a small fittings circular such as the firm is sending out to its customers.

The London Battery Company, of Westminster, announce that they have disposed of their business to the Atlas Carbon and Battery Company, Limited, Ewer Street, London, S.E.

Messrs. Geipel & Lange notify that owing to the rapid increase of their business, they are removing to new and larger offices at Parliament Mansions, Westminster, to which all communications should in future be addressed. The same remarks apply to the trading and contract business of Messrs. Paterson & Cooper, which was taken over by Messrs. Geipel & Lange, and forms a part of their business.

**Waverley Electric Car.**—In our recent review of the motor-carriage exhibits at the Royal Agricultural Hall Exhibition, we omitted to notice the Waverley "Run about" of the Automobile Association, Limited. We are given to understand that this car is

able to take gradients of 1 in 10, to run an average of 40 miles with one charge and at speeds up to 16 miles an hour. It is claimed to be silent, economical, and low priced. The "Run-about" weighs 12 cwt. and the "Stanhope" 13½ cwt. The motor is of the multipolar type carefully designed for overloads, it is rigidly hung to the frame of the running gear, and it and all gears are carefully covered, amply protecting them from dust and water, so that in cleaning the carriage only moderate care need be exercised. The motor shaft is geared directly to the two rear wheels by a single reduction. Each rear wheel is made to revolve independently of the other by compensating

gears placed in line with the motor shaft. The motor is of 1½ H.P. and the battery employed, said to be covered by broad patent claims, is of a new type, and less than half the weight of the storage cells used in other cars of the same capacity. The normal discharge rate of the battery is about 15 amperes, at which rate the car runs at a speed of from 12 to 14 miles an hour. One simple ratchet lever is all there is for the manipulation of the car, five ahead and three astern speeds being provided. The controller contacts are sliding and self-cleaning, and so constructed that burning at these points when shifting the speed circuits is prevented. A band brake will stop the vehicle in its own length at full speed. The frame work is tubular, all wheels have ball bearings, pneumatic tyres, and wire spokes, and the whole car runs therefore as easily as possible. This car is turned out as "Run-about," with seating capacity for three, and as "Stanhope," for two persons, with hood.

**X Rays on the Stage.**—In a melodrama recently produced in suburban London, entitled "Thou shalt not kill," the X rays are employed to locate a bullet. As the conditions of the theatre are not exactly suitable for the actual use of coil tube and screen, Messrs. Harry W. Cox, Limited, were entrusted with the work of devising an efficient substitute. This they have achieved most successfully, and the effect was quite easy to mistake for the real thing. The manager of the company carries round a complete X ray outfit, which is exhibited during the day, tickets being distributed at the evening performances.

## ELECTRIC LIGHTING NOTES.

**Barnsley.**—The Town Council will apply to the Local Government Board for sanction to a loan of £3,000 for extensions of the electricity works.

**Blackburn.**—Major-General Crozier, R.E., an inspector of the Local Government Board, held an inquiry on August 1st, relative to the application of the Blackburn Corporation for power to raise loans of £25,000 for the purpose of electric lighting.

**Bolton.**—The electrical engineer, Mr. A. Ellis, has reported to the Electricity Committee on the subject of street lighting. He prefers the rectifier system for Bolton, with the arc lamps mounted on every second pillar, 80 yards apart, and two 16-C.P. lamps on every post, 40 yards apart. The latter would replace the arcs at midnight. The price per annum would be £18 per arc at 80 yards, £16 at 60 yards, and £15 at 40 yards; while the glow lamps would cost £2 2s. per annum per 16 C.P., including renewals, as against £2 5s. for gas.

**Bristol.**—On August 3rd an accident occurred at the Central Electric Lighting Station to H. J. Arnold, a linesman in the employ of the Corporation. He was engaged in some work on the switchboard at the time, and it is assumed that in reaching for something he inadvertently touched the high pressure terminal and received a shock, resulting in severe burns. Artificial respiration was resorted to successfully, and the injured man, who had also had a bad fall, was removed to his home. It is intended to find accommodation for him in the General Hospital, and it is hoped that he will speedily recover.

An exciting incident took place last week in Nelson Street, where the electric cable is being laid. The workmen had left one of the drums standing in Broad Street, and by some means or other it started rolling down the slope, and crashed into a public house, completely demolishing the front of the premises. Several persons had narrow escapes, but fortunately, no one was injured.

**Carlow.**—The overhead wires of the electric supply network have been replaced by underground cables by Major Alexander, the proprietor of the works.

**Ceylon.**—The Colombo Council has accepted Messrs. Boustead Brothers' undertaking for the electric lighting of the tramway routes, and a contract has been entered into. Messrs. Boustead Brothers undertake to supply and erect, at their own cost, an installation of 88 arc lamps, of 10 amperes capacity each, along the Grandpass and Maradana tramway routes, commencing in each case from the point where the Fort arc lighting ends. These lamps will be mounted on carriers on the top of the tramway posts, and will be an average distance of about 120 yards apart over some six miles of streets, which will afford a very efficient and handsome illumination of the roads in question. The firm also undertakes to supply the current for these lamps, carbons, trimming and attendance, all supervision, maintenance and repairs, for the sum of 13 cents per lamp per hour, provided the Council agrees to the following conditions:—(1) Agreement to be for period of tramway agreement. (2) The Council to have the option of acquiring the installation and the necessary plant from us at the expiry of the agreement. And (3) the Council, in the event of its being decided to take over the tramways, to further agree to take over this installation and the necessary plant also in good order and condition, it being held to be reasonably modern and up to date. This point to be decided upon by arbitrators appointed for the purpose in the usual manner, and such arbitrators shall also value the plant and installation, should it be decided that the Council shall acquire the same. Messrs. Boustead Brothers have been granted permission to run electric launches on the Colombo Lake and to erect landing stages at different points.

**Cleethorpes.**—The District Council has resolved to procure a provisional order for the supply of electricity for lighting and traction.

**Clewer.**—The Parish Council is considering an application from the Windsor Electrical Installation Company to lay cables in their parish.

**Continental Notes.**—FRANCE.—The establishment of a central station in the town of La Motbe-Saint-Keraye (Deux Sèvres), has just been decided upon.—A company has been formed at Lyons (11, Rue de l'Hôtel de Ville), with a capital of £110,000, to be known as La Société Electro-Chimique de la Romanche.

GERMANY.—According to the official statistics of the empire, just published, it appears that 13 per cent. of the cities of Germany practice municipal ownership of electric light plants. Of the cities with a population of more than 10,000, 517 in number, 120, or more than 23 per cent., own their own electric lighting plants. Of the 2,700 smaller cities, 300, or 11 per cent., have municipally-owned plants.

**Derby.**—The Town Council has reduced the charges for electricity from 6d. per unit for the first 1½ hours of maximum demand and 3d. afterwards, to 6d. for the first hour and 3d. afterwards. The £400 deficit of last year has been changed to a surplus of £789, and the demand is increasing rapidly.

**Dover.**—The trolley wires were struck by lightning recently during a heavy storm. Beyond throwing out the circuit-breakers and stopping traffic for a few minutes, no harm was done.

**Dudley.**—The Town Council, at a special meeting on August 2nd, adopted the recommendation of the Railway, Tramway, and Electric Lighting Committee to obtain a loan of £33,000 to carry out a scheme of electric lighting for the borough.

**Durham.**—The electric lighting provisional order having been confirmed by Parliament, the Town Council has resolved to consult Mr. Hawtayne on the subject, and to negotiate for the transfer of its powers to a company.

**Eton.**—After a battle, which has lasted upwards of two years, the advocates of electricity for street lighting on the Urban District Council have defeated the opposition, several of whom are shareholders in the Gas Company, and on Thursday, last week, the tender of the Windsor Electrical Installation Company was accepted to light Eton with the electric light. Originally, Eton was supplied with 72 gas lamps with a candle-power of 1,460 at an annual cost of £303 18s. This will be replaced by 12 500-C.P. arc lamps and 42 16 C.P. incandescent lamps, equivalent to 6,672 C.P., at a cost of £336 5s. Thus, for an increased expenditure of £32 7s. per year, there will be an additional candle-power of 5,212.

**Exmouth.**—On Mr. Hammond's advice, the District Council has decided to apply for a provisional order.

**Fife (N.B.).**—At a meeting of the St. Andrews District Committee of the County Council on July 31st the Tayside Electric and Gas Light Company and the Newport Gas Light Company gave notice that they intend to apply to the Board of Trade for a provisional order to authorise the supply of electricity within the parish of Forgan.

**Godalming.**—The Town Council has accepted the offer of Edmundson's Electricity Corporation, Limited, to take over the Council's provisional order for public and private electricity supply. The Council has the option of purchase at the end of seven years for a sum equal to four-thirds of the capital expended, or after 14 years for five-fourths of the capital, or any time after seven years upon payment of the capital plus a sum sufficient to make up the dividends paid by the company to 10 per cent. per annum from the start down to the time of purchase.

**Hampstead.**—The annual report and statement of accounts of the Hampstead Vestry's electric lighting installation shows that the total capital raised was £126,570; during the year 1898-99 over £11,000 was spent on new machinery and nearly £7,000 on new mains, together with £2,200 on new buildings. The income for the year was £24,377, an increase of 53 per cent. on the preceding year. The gross profit was £13,014, and the net profit £8,339, or 6·65 per cent. on the total capital expended. It is proposed to invest £7,500 of this in Government stock as the nucleus of a reserve fund.

**Hereford.**—The County Council proposes to supply electricity on the following terms:—For the first two hours per day, 6d. per unit; for each hour afterwards, 4d. per unit; for motive power, 3d. per unit; for hire of meter and M.D. indicator, 4s. per quarter.

**High Candle-Power Incandescent Lamp.**—According to the *Marine Engineer*, the Bryan Marsh Company of New York has been experimenting with incandescent lamps, which are greatly superior to arc lights in a fog, since the yellow rays of the incandescent light are not so easily damped out and absorbed as the rays of the arc light. The company made a lamp of 5,000 C.P. with two filaments, each taking 236 volts and about 3 watts per candle; the lamp thus took about 15 KW. It burned out in three nights, due probably to the intense heat at the neck.

**India.**—Part of the Madras General Hospital is being lighted with electricity as an experiment.

Mr. B. N. Sen, a native of India, formerly a student of the Sibpur Engineering College, and later engaged with Messrs. Kilburn & Co., has been appointed chief engineer of the Calcutta Electric Lighting Co.

**Islington.**—The long outstanding dispute between this Vestry and the St. Pancras Vestry on the subject of laying mains on the boundary line of the parish was practically settled at a meeting of the Islington authority on Friday. In a report on the subject the General Purposes Committee stated that, in view of an intimation received from St. Pancras that it proposed to lay mains in Brecknock and York Roads for the purpose of supplying current to consumers in St. Pancras, the Vestry referred the matter to the vestry clerk and the solicitor, with instructions to obtain an injunction prohibiting the work being commenced, or to take such other steps as might be necessary for preventing the Vestry from interfering with the roads in Islington; and that subsequently a communication was received from St. Pancras stating that, after reconsideration, it had decided not to give effect to its previous intention of interfering with the roads without permission, but that it was desirous of sending a deputation with a view to some arrangement being come to in the matter. The General Purposes Committee further stated that the deputation duly attended, and admitted that St. Pancras had no statutory power to lay mains in Islington, and that the Vestry had no authority to accord permission to do so. The committee were nevertheless of opinion that too much importance should not be attached to the point, and had consulted the solicitor as to how the Vestry's interest could be adequately protected if the application were acceded to. The solicitor had advised the committee that the matter might be met by the Board of Trade granting a license to the St. Pancras Vestry to supply electricity in the roads in question under Sec. 3 of the Electric Lighting Act, 1882. On the recommendation of the committee the Vestry unanimously resolved to inform St. Pancras Vestry that if it deemed it advisable to apply for such a license the Vestry would be prepared to give consent to its being granted.

**Kirkwall.**—The Town Council has appointed a committee of inquiry into the question of electric lighting. Mr. Drever moved that it be remitted to a committee to inquire and report whether it be advisable for the Corporation to introduce into the burgh lighting by electricity. He had, he said, no opinion, had no right to have an opinion in view of want of information on the subject, and he approached it with an entirely open mind. He might approve of introducing electric lighting or he might not, but he would like information, and he thought the community would like it. Other communities, including Lerwick, were looking into the subject. The motion would also let the outside public and others know that the subject was being looked into, and would keep private interests from intruding themselves, which, in these days of corporation enterprise should be avoided. Mr. Drever then referred to a letter which had been received by a gentleman in town from Mr. York, the electrical engineer who had charge of the installation of electric light in Fort William, offering to supply any information on the matter. Information might also be got from Lerwick. Dean-of-Guild Flett seconded the motion, which was agreed to, and the following committee was appointed:—Bailies White and Sclater, Dean-of-Guild Flett, and Messrs. Sutherland, Baikie, and Drever—Mr. Drever to be convener.

**Llanelly.**—The Council has received various proposals for the supply of electricity for lighting and traction, and is considering the question of terms, &c.

**Manchester.**—A gas explosion occurred in an electrical conduit in King Street on August 8th. No serious damage was done.

**Newport (Mon.).**—The manager's quarterly report shows cost of generation and distribution per unit, 3 11d., against 4 78d. last year, and total revenue, £1,351 0s. 7d., against £863 4s. 5d. last year. The number of lamps connected and on order is equivalent to 30,318 8-C.P.

**Paris.**—A daily paper says that two offers to light the Bois de Boulogne by electricity have been laid before the Council by private individuals, M. Mildé and M. Tavernier. M. Mildé proposes to set up an electrical installation, but not at his own expense, the cost to be spread over 14 years. For furnishing the light and maintaining the works he asks for an annual subsidy, much smaller than the amount which the city would have to lay out if it undertook the work itself. M. Tavernier asks for a similar subsidy, but is willing to erect the necessary plant at his own expense. The cost of lighting the Bois is estimated at about £2,000 a year.

**London, E.C.**—The chairman of Milner's Safe Company, Limited, last week told the shareholders that they had carried £7,000 to reserve for the electrical equipment for which they had contracted. It was a large outlay, but was necessary to keep the works up to date. A large saving would result by the introduction of electricity for driving all the machinery and lighting the buildings.

The following letter appeared in the *Pall Mall Gazette* on 3rd inst.:—

Sir,—The report of your interview with the City Company gives a fair idea of the situation created by the decision of the House of Lords giving the right to compete to the Charing Cross Company. That decision has brought about—perhaps somewhat prematurely—a condition which I foreshadowed in a letter published on June 20th, which, after referring to the immense outlay necessary, goes on—

Then what happens? The Charing Cross Company will offer for 5d. what the City of London Company offers to supply in January for 6d. But when the former company is ready, the latter will then come down to 5d. The effect of this would be to ruin the Charing Cross Company by rendering their outlay unproductive, for is it likely that City consumers will put up with all the nuisance involved in changing over to a new company when they will be having the same thing at the same price from the old company?

The City Company has taken a much bolder step than I anticipated. It has come down to 4½d., and that, too, before the Charing Cross Company has laid out 1d. in the City. This move has entirely knocked the bottom out of any hope of success that may have hitherto buoyed up the Charing Cross Company. But a far graver issue has yet to be fought—namely that of the validity of the contracts between the Corporation and the City Company. If they are valid, competition is impossible. If they are not, an action for damages will lie against the Corporation by the City Company.

The City Company has given the Corporation the opportunity of getting out of this "cleft stick" by buying up the whole concern at a price which will yield about the same figure to the ordinary shareholders as that at which the last issue of shares took place—namely, £8, and at an immediate profit to the ratepayers of £45,000 per annum. It is a pity the Corporation does not avail itself of this offer.

J. W. MARTIN.

The *Pall Mall Gazette* has now interviewed the Charing Cross and Strand Electricity Supply Corporation with a view to hearing its side of the City electric lighting question. The interviewer found the company in a state of restrained triumph. The action of the City Company in reducing the charge to 4½d. per unit seemed premature by at least 18 months; it seemed like cutting off the nose to spite the face. But the suggestion that the Charing Cross Company will be thereby deterred from following out its design is far-fetched and unfounded.

When the Charing Cross Company has made up its mind, it is not in the habit of changing it. The company, our representative was assured, means to go into the City. Its entry to the Strand proved a good thing for all parties; the reduction in the price of electricity led to an enormous increase in the number of lamps. Why should not something of the same sort happen in the City?

As for anything in the nature of collusion between the Corporation and the Charing Cross Company, our representative was assured that there had been nothing whatever of the kind. On the contrary, the Corporation attempted to impose conditions by no means favourable to the company. In some instances, the Corporation was successful, but in the case of the restrictive conditions proposed by the Board of Trade, not one of them was allowed to stand. In everything, except the calling of witnesses, the Corporation behaved kindly to the City Company. To talk of the Lords' decision being upset in the Law Courts is absurd. The Charing Cross Company is working under Act of Parliament, a sort of thing which is not usually upset in the Law Courts.

Had it been decided that the agreement between the Corporation and the City Company was valid, the Electric Lighting Act of 1888 would *ipso facto* have been stultified. That Act specifically precludes monopoly. Moreover, the very fact of the Corporation having tied its hands by entering into this agreement precluded it from being in a position either to give or withhold its consent to the introduction of competition. The very words, "so far as we are able," with which the Corporation qualified the undertaking to exclude competition should have enforced these facts upon the attention of the City Company's directors. Also, that limitation should have been brought under the notice of intending shareholders.

Throughout the contest the Charing Cross Company has behaved in a scrupulously fair and straightforward manner; there has been nothing whatever in the nature of backstairs procedure, and nobody has been able to suggest that there has, let alone support the suggestion.

**Rio de Janeiro.**—The gas company of Rio de Janeiro has been successful in securing an extension of its privilege for the lighting of the city by gas until the year 1940. From July 1st it also secures the right to supply electricity to the year 1915. The distribution of electricity is to be by underground cables, and the public lighting will be by arc lamps.

**Ripley.**—The District Council has received two tenders from experts for surveys and reports on the electric lighting of Ripley; that of Messrs. Page & Medhurst, of Manchester, for 30 guineas, was accepted. Has it come to this, that consulting engineers nowadays bid against each other, cut prices, and so on? How are the mighty fallen!

**Sheerness.**—The District Council has resolved to offer no opposition to the Electrical Power Distribution Company's application for a provisional order for the installation of the electric light at Sheerness.

**Sevenoaks.**—The District Council is considering the question of electricity supply in the district.

**Sheffield.**—The trade unions continue to pass resolutions hostile to the Lighting Committee's contract with Messrs. Ferranti; we sincerely trust that the committee will stand fast, and that the Council will support its views of what constitutes "a fair contract." All honour is due to Messrs. Ferranti for their stubborn resistance to what is really an underhand renewal of the question of the strike—shall an employer be master of his own workshops?

The difficulty arose through the refusal of Messrs. Ferranti to insert the so-called "fair wages" clause in their contract for electric lighting machinery for the City Council. This clause has been included in all municipal contracts in Sheffield for several years, but

the Electric Lighting Committee decided to make an exception in this instance. The clause enforces the standard rates of wages and hours recognised by the local trade unions for all work done in Sheffield, and, for work done elsewhere for use in Sheffield, the minimum standard rates recognised by the societies where the work is done, under penalties. It should be observed, however, that a clause enforcing the hours and wages recognised by the Masters' Federation and the Men's Trades Unions for the Oldham district was embodied in the contract, with free access to works and wages books on the part of the engineer to the Corporation. The present contract is for a 1,000-KW. steam alternator costing £9,500, and a new switchboard, which is to cost £1,500. Messrs. Ferranti have already supplied plant of about 1,800 H.P. to the city.

As we go to press we hear that the Council has endorsed the action of the Committee by a majority of three votes. We congratulate Messrs. Ferranti on their victory.

**Southend.**—At a Council meeting held on July 12th, it was decided to refer to the ratepayers and residents the proposed transfer of the electric lighting powers to Mr. A. H. Gibbings, whose terms were considered to be more favourable than those of any other party offering. The Council voted 9 in favour of deferring the matter, and 11 against, after which the resolution was agreed to calling upon the town to express its opinion, and referring the matter back to the committee for that purpose. The public meeting was duly held last week, 120 persons being present, and by 40 votes to 30 it was resolved "that it is in the best interests of the town that the Corporation should carry out the order *if carried out at all*." It seems that there was no one present who knows much about the matter, or the absurdity of the last five words would not have escaped attention. The ratepayers, fortunately, are not the controlling authority, and the Board of Trade will, in keeping with its recent vigorous policy, see that the Council is not permitted to sit indefinitely upon its order, while private parties are willing and anxious to turn it to account. There is nothing more unsatisfactory than calling public meetings to settle such a question as electric lighting, particularly in the height of the seaside season, when there is difficulty in getting the right people together. A general poll is better, but not much, for we question whether 9 out of every 10 residents are well enough informed to vote wisely. We do not know to what extent the Council will consider itself bound to abide by the ruling of its constituents, but whoever does the work, it is to be hoped that the delay will not be further prolonged. A good deal of nonsense was said about Mr. Mitchell, the borough electrical engineer, having been connected with Mr. Gibbings at Bradford. The fact is, that Mr. Mitchell was chief assistant electrical engineer at Bradford from 1889 to 1894, and Mr. Gibbings was not appointed to Bradford until 1895.

**Stalybridge.**—The District Council proposes that a joint scheme of lighting and traction should be entered into by Ashton, Stalybridge, and Dukinfield.

**Surbiton.**—The District Council has decided to lease its provisional order to Callender's Cable and Construction Company, Limited. The Council will find the capital, and the company, in return, will pay interest on the sinking fund. The Council has the option of taking over the undertaking at the end of five years, paying a premium of 2 per cent. per annum.

**Torquay.**—The Princess Pier and Gardens and the Haldon Pier are to be electrically lighted at a cost of about £620.

**Wallsend.**—The Royal assent has been given to the Bill of the Walker and Wallsend Gas Company to authorise them to supply electricity in Wallsend, Willington and Willington Quay.

**Warrington.**—Tenders amounting to £50,986 2s. 6d. for the construction of the new destructor premises and plant, the new electric lighting premises and plant, and other works in connection therewith, were accepted by the Town Council last week, subject to the approval of the Local Government Board.

**West Bromwich.**—The Electric Lighting Committee having appointed Mr. R. C. Quin, of Blackpool, as their consulting engineer, he has prepared a report showing a scheme for the supply of electricity within the compulsory area. The committee recommends application to the Local Government Board for sanction to borrow £30,000 for the purpose of laying down plant and mains.

The Mayor made an important statement at the last meeting of the Council. After congratulating the Council upon having retained their right to supply electricity, he pointed out that had they once parted with that power it would have taken an enormous amount of money to have obtained it again. The demand for electricity in the borough was very encouraging, and they found that in the compulsory area of supply 300 H.P. would be required for generation purposes. For lighting purposes the demand was 171,000 units, and for power purposes 100,000, thus making a total of 271,000 units, but that did not include the quantity that would be required for working the trams. They had a double track extending for five miles, and for that 300,000 units of electricity would be required, whilst another 50,000 would be utilised on the Spon Lane and Bromford Lane routes. After referring to the proposed charges to consumers, he said that there was a good demand for electricity outside the compulsory area, and that the prospects of the success of the scheme were very bright.

**Worcester.**—Mr. E. A. S. Fawcett, A.M.I.C.E, Local Government Board Inspector, held an inquiry last week into the application of the Council to borrow, with other loans, a sum of £3,000 for electric lighting purposes.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

**Barnsley.**—An inquiry was held at Barnsley on August 2nd, by Mr. G. A. R. Fitzgerald and Col. Boughey, Light Railway Commissioners, into the application of the British Electric Traction Company, Limited, for powers to construct light railways in the district. Evidence having been given, the Commissioners announced that the application was granted with regard to railways from Barnsley to Worsborough and Monk Bretton, but a third railway, to Huddersfield Road, was struck out on account of the narrowness of Church Street, through which it would have passed.

**Birmingham.**—Messrs. Brown, Marshalls & Co., Limited, have adopted electrical driving in place of steam.

**Bombay.**—The Bombay Tramways Company contemplates an early application of electricity upon its lines. The overhead trolley system, which is stated to have worked for three years at Madras and Colombo, and is about to be introduced at Calcutta, is proposed. The managing director of the company has addressed a letter to the Municipal Commissioners extolling the virtues of the trolley as compared with the other systems of traction. A correspondent at Bombay writes to us expressing the opinion that this is a fitting opportunity for electrical firms to start there. An agent of Messrs. Siemens is arranging to start electric lighting there as soon as he can obtain the Government sanction, he having received a number of promises to take current from hotels, &c, and there is every prospect of the concern being a success. Bombay is anxious not to be behind Calcutta and Madras. The gas company has at present a good hold on the town, though there are some 30 or 40 separate electrical installations, besides a large number of cotton mills which have their own plant.

**Bristol.**—The Bristol Tramway Company has recently signed a contract with the British Thomson-Houston Company, Limited, in connection with the large extensions now in progress. The order includes four 500-KW. tramway generators coupled direct to vertical cross-compound engines of the Corliss type, together with three 30 KW. motor generators, and two 50-KW. lighting machines; a complete switchboard for this machinery, and 150 single truck double-deck cars complete, each of which will be equipped with two G.E.-52 motors, series parallel controllers and magnetic brakes.

**Burgdorf-Thun Electric Railway.**—Switzerland possesses electric tramways as well as electric mountain cable railways in plenty, but a full-gauge railway worked by electricity, capable of accommodating a considerable passenger and goods traffic and over whose lines the through traffic from other railways can pass, forms a new departure. This line, which runs from Burgdorf (on the Great Central Railway) to Thun, in the Bernese Oberland, was opened for traffic last month. The gauge is the usual one for all Swiss through lines—namely, 1·435 metres—so that all the rolling stock of other lines can pass over it. The motor-cars, with accommodation for passengers, weigh 32 tons; the ordinary light passenger carriages, to be drawn by either motors or electric engines, weigh a little over 10 tons. The contact between the car and the overhead cable, which works at a pressure of 830 volts, is effected by a stirrup, held up by two poles. The power is supplied by an overhead line at 15,000 volts, from the new electric power works on the river Kander, in the Bernese Oberland. The 12 trains which pass over the new line in either direction daily consist usually of a motor and a light car. The electric engines, which on emergency can also be used for passenger trains, are intended to cope with the goods traffic, and are capable of drawing 120 tons over the whole line, including gradients up to 1 in 40. The journey from Burgdorf to Thun takes 1½ hours, and opens up some fine hilly country, studded with prosperous farmhouses and rich villages, hitherto almost unknown to the thousands of tourists who visit Switzerland every year.

**Canadian Niagara Power Company.**—The Government of Ontario has ratified a new agreement with the above company, under which the monopoly clauses are cancelled, and a new rental has been fixed. Other companies are now free to enter the field, and five or six are already organised for that purpose. According to the new agreement the company must have completed by July 1st, 1903, water connections for the development of 25,000 H.P., and must have 10,000 H.P. actually available. The rental will be a minimum of £3,000 yearly, together with 4s. per annum per E H.P. generated up to 20,000 H.P., 3s. for each additional H.P. between 20,000 and 30,000, and 2s. above 30,000. The company proposes to lay down plant for 100,000 H.P. at least. In the meantime power will be generated and distributed from the Niagara Falls Park and River Railway Company's works, which are the property of the Canadian Niagara Power Company.

**Continental Notes.**—RUSSIA.—La Société de l'Industrie Minière de Zyrianowsk is installing a large electric power transmission plant at its mines at Zyrianowsk (Alta du Sud). Water-power is being utilised.

HOLLAND.—An electric tramway has been completed and opened for traffic between Haarlem and Zandvoort. The line, which has a length of about 10 miles, has been constructed by Messrs. Siemens and Halske, of Berlin. The plant at the generating station comprises three 170-H.P. steam dynamos.

ITALY.—A contract has been placed with Messrs. Felix Singer and Co., of Berlin, for the construction of about 30 kilometres of electric tramways in and about the town of Catania.

**Cradley Heath.**—Messrs. Holt & Willetts, engineers and large chain manufacturers, have laid down a plant in their works for electric power to take the place of steam power.

**Darlaston.**—A sub-committee has been appointed by the Urban District Council to consider the desirability of acquiring the portion of the South Staffordshire tramways running from the Bull Stake to Moxley within the Council's district, and to report as to the best means of dealing with the same. A communication has been received by the Council from the Midland Electric Corporation with reference to the supply of electricity, but the clerk has informed the Council that he does not see how it affects them as they do not propose to work their tramways.

**Darlington.**—The Town Council on August 3rd approved of the scheme of the Imperial Tramways Company for light railways in and about Darlington. The Council has power to purchase the undertaking at the end of 25 years at its then value.

On August 4th an inquiry was held by Colonel G. A. R. Fitzgerald and Colonel Boughey, C.S.I., Light Railway Commissioners, and Viscount Emlyn, assistant secretary of the Commission, into the application of the Imperial Tramways Company for a provisional order for the construction of light railways in and about Darlington. The proposed system would have 9 miles of line, 3 feet 6 inches gauge, and would cost £77,000. The company also applied for a provisional order to lay cables for transmitting power from Stockton to Darlington to work the tramways at 5,000 volts. The County Council, the North-Eastern Railway Company, the Stockton District Council, and the Stockton and Darlington Corporations, were all favourably disposed to the company's application. Mr. Clifton Robinson, managing director of the company, explained the details of the scheme to the Commissioners. An unexpected opposition cropped up on the part of certain ratepayers, who advocated municipal control. A Sunderland lawyer, who claimed to be an expert in electric tramways, was crushed amid laughter by the question: "What is the difference between an alternating and a direct current?"

On August 5th, at Middlesbrough, the Commissioners announced their decision, to the effect that the order would be granted; but they thought that arrangements should be made for the supply of power by the Corporation, in place of transmission from Stockton. The company undertook to endeavour to carry out such an arrangement.

**Dewsbury and Spen Valley.**—On August 1st Mr. G. A. R. Fitzgerald and Col. Boughey, Light Railway Commissioners, held a public inquiry at Dewsbury into the application made by the British Electric Traction Company, London, for powers to construct electric tramways from Dewsbury to Heckmondwike, Liversedge, Cleckheaton, and Ravensthorpe. The inquiry opened at 10 o'clock in the forenoon, and was not concluded until 6 o'clock in the evening. Ravensthorpe, Liversedge, and Gomersal District Councils supported the application. The Corporation of Dewsbury and Batley and the District Councils of Heckmondwike and Cleckheaton opposed. It was stated that Dewsbury, Heckmondwike, and Cleckheaton had agreed to promote a scheme of their own in the event of the company's application failing. After hearing counsel for each authority interested and a large number of witnesses, Mr. Fitzgerald said it seemed to be admitted on all hands that a light railway would be useful to the districts. They did not ignore the weight which ought to be attached to the views of the local authorities, but, having regard to the division of opinion which existed, they were prepared to grant the order to the company. The company, however, should consider the desirability of conceding to the local authorities the right to break up their own streets where it was desired, and in other respects the Commissioners felt that the company, in adjusting details, should pay regard to the wishes of the various authorities. An undertaking in accordance with the Commissioners' suggestion having been given by Mr. Balfour Browne, the inquiry terminated.

**The Dublin Trolley Mishaps.**—In the House of Commons last week Mr. Patrick O'Brien asked the President of the Board of Trade whether he was aware that three passengers on an electric tramcar in Dublin on Sunday last were injured by the breaking of the electric wires, which was caused by a passenger pulling the trolley rope in mistake for the bell rope to stop the car; whether he was aware that Mr. Mahony, the magistrate before whom a police charge was brought arising out of the accident, censured the tramway company for exposing the public using the trams to the danger of pulling the trolley rope by mistake for a bell rope, and also censured the Board of Trade for having sanctioned such a dangerous arrangement. Mr. Long (for Mr. Ritchie) replied: "The Board of Trade have entered into communication with the company with reference to this matter. When their reply is received I will decide whether an expert inquiry will be useful. In the meantime I can express no opinion on the subject."

**Farnworth.**—The District Council has definitely refused to accept the terms offered by the Bolton Corporation for the supply of electrical power for purposes of traction and for lighting, and has decided by a large majority to put down an installation of its own and work both.

**France.**—Five new lines of electric tramways are about to be constructed in the town of Rouen.

**Gateshead Tramways.**—At a meeting of the shareholders in the Gateshead Tramways Company, on August 2nd, it was resolved that the proposed Gateshead and District light railway order, 1899, a draft of which had been submitted to the meeting, should be approved.

**Glasgow.**—A deputation of six or seven members of the Glasgow Corporation visited Dublin last week for the purpose of inspecting the working of the electric tramway system of the Dublin United Tramway Company.

**Hull.**—The City Council has passed a resolution that the tramcar service be discontinued on Sundays.

**Jungfrau Railway.**—A further section of this remarkable engineering undertaking has been completed, and was formally opened on August 1st. The tunnel has now been driven through the Rothstock, the rails laid, and the electric conduit fixed for a length of 763 yards from the tunnel mouth below. To make room for a station the rock had to be blasted to the right and left of the upper end of the tunnel. Galleries similar to those in the well-known gorge of the Aare, near Meiringen, have been built outside the Rothstock on its eastern face, so that passengers may enjoy the panorama. The work, says the *Westminster Gazette*, is being continued from the Rothstock right inside the Eiger, and in a year's time the engineers hope to drive the tunnel up to the third station, called beforehand the "Grindelwaldblick."

**Lambeth.**—The Vestry at the last meeting considered a letter from the London County Council asking for consent to the Council applying to the Board of Trade for a license to introduce the conduit and surface contact systems on the tramways between Westminster Bridge and Tooting. After some discussion it was decided to give the desired permission, on the understanding that all disturbances of the roads were to be subject to the approval of the Vestry's surveyor, and "the pattern subject to the approval of the Vestry."

**Leeds.**—The Tramways Sub-Committee has decided to request the consulting engineer to invite tenders for 50 more cars, to keep pace with the extensions of the works. There are many cars on order already which have not yet been delivered, owing to the great demand at present existing.

**Lincoln.**—Mr. Vesey-Brown, the city electrical engineer, has reported to the Town Council on additions and alternatives to the tramway routes on which he reported in May last. The extra cost is estimated at £5,500, additional to the original estimate of £11,137. The Council will apply to Parliament for powers to carry out the scheme.

**London United Tramways.**—A contract has been signed with the British Thomson-Houston Company, Limited, covering the electrical equipment, engines, cars, trucks, &c., for that portion of the London United Tramways upon which it has been resolved to introduce electric traction, in Hammersmith, Chiswick, &c. The contract includes six 250-KW. 550-volt direct current traction generators and one 94 r.p.m. 5,000-volt three-phase generator, driven by vertical Corliss engines; 13 75-KW. 5,000-volts primary, 330-volts secondary, static oil-cooled transformers; four 200-KW. 500 r.p.m. 530-volt rotary converters; one motor generator set, consisting of a 550-KW. three-phase synchronous motor direct coupled to two 250-KW. direct current generators on combination bed-plate; two 75-KW. 400 r.p.m. 525-volt direct current generators for lighting purposes; and also complete switchboards for the whole plant. One hundred cars of top-seat pattern, each mounted on two trucks and equipped with two G.E. 58 motors. Series parallel controllers and magnetic brakes are also included in the contract. It is intended to have the new service in operation next June.

**Manchester.**—Messrs. Isaac Storey & Sons, of the Empress Foundry, Manchester, have recently considerably enlarged their works, and have adopted electric driving throughout. The whole of the new arrangements have not yet been completed, but at present there are two main dynamos of 200 amperes at 230 volts each, both being driven from one countershaft with clutches, so that they can be used either separately or together. The engine is of the Proell-Corliss type, of 100 H.P., made by the firm. There is also to be put down a direct coupled plant of about 100 amperes for office lighting and to meet the requirements of overtime working in a small section of the establishment.

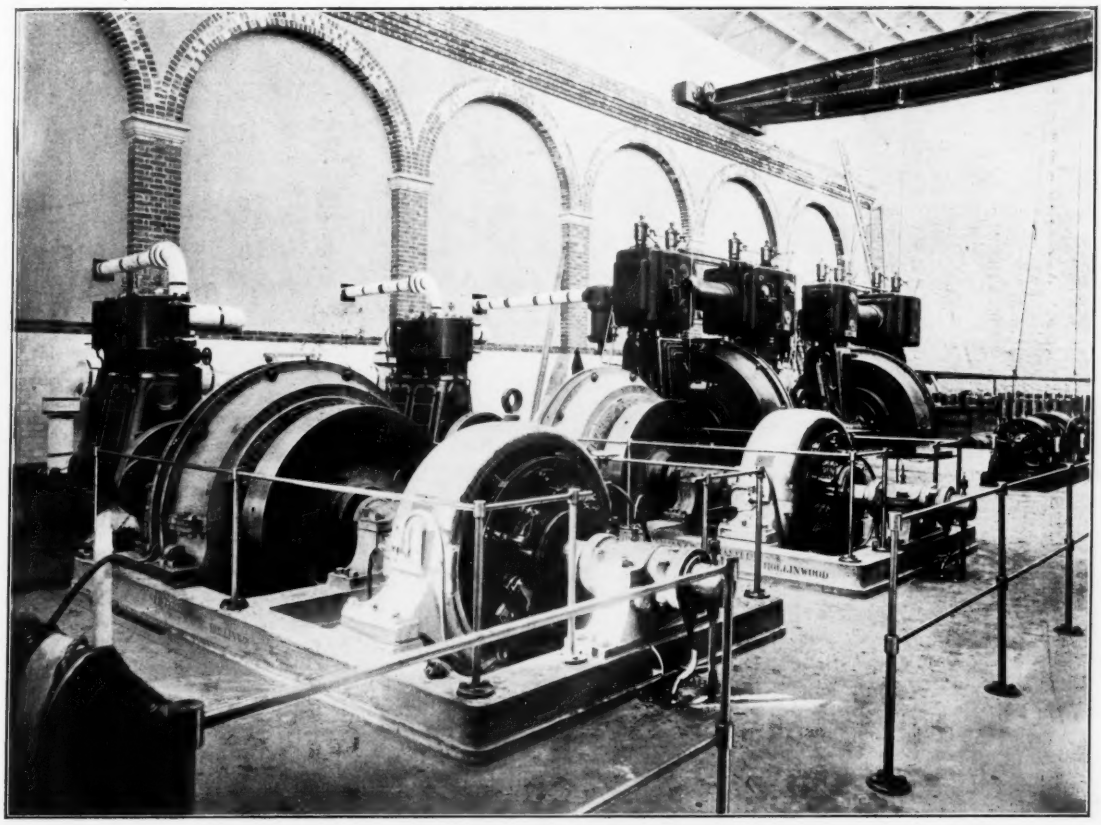
**Middlesbrough.**—Cols. Fitzgerald and Boughey, Light Railway Commissioners, and Lord Emlyn, assistant secretary, held an inquiry on August 5th into the application of the Imperial Tramways Company, Limited, for powers to carry out extensions of their tramways at Middlesbrough. The present application was to run the line through Ormesby, Normanby, and South Bank, nearly to Grangetown. The opponents to the scheme were local landowners. The inquiry was adjourned *sine die*, in order that the parties might arrange terms.

**Nottingham.**—Messrs. A. Brown, city engineer, and H. Talbot, electrical engineer, have issued their report to the Council on their return from inspecting tramway systems in America. The report contains little that has not already appeared in the technical press, and, as the authors say, "engineers in England have nothing whatever to learn in America as regards the construction of the overhead work of the trolley system." We should like to know why, therefore, do English engineers persist in going to America, when there are first-class overhead systems to inspect at home? Some interesting details of the new power station of the Metropolitan Street Tramways Company, of New York, are given in the report. The estimated cost of the station is about £1,000,000, and it will contain generating plant of 66,000 H.P. There are 87 Babcock and Wilcox boilers, of 500 H.P. each, in three tiers; the chimney shaft is 353 feet high, 22 feet diameter at the top, and weighs 8,840 tons. Storage is provided for 10,000 tons of coal, which will be handled by mechanical conveyors. There will be 8 or 10 sub-stations, transforming from 6,000 volts three-phase to 500 volts direct.

(*Continued on page* 241.)

## PLYMOUTH LIGHTING AND TRAMWAYS.

At the present moment unusual interest attaches to combined lighting and tramway systems, and though the Plymouth system, which we have recently had the pleasure of inspecting, is not in the front rank as regards size, yet it possesses special engineering features which render it one of the most important plants erected in this country. We believe that the Plymouth combined system was the first proposed in England; at any rate, Mr. Rider, the borough electrical engineer, was one of the first municipal engineers to advocate combining electrical machinery both for lighting and tramway purposes, and on different occasions he has both in the public press and elsewhere advanced the claims of such methods. It need hardly be pointed out that opinions are very much divided amongst engineers as to the advantages of placing the necessary machinery for lighting and tramways under one roof and under one management. Much can be urged on both sides of the question. It would seem that the generation of electricity, whether required for lighting or tramway purposes, could be better carried out in one place rather than by duplicating works. In the opinion of some, the force of this argument may appear less from the fact that one of the most important tramways and lighting systems in the kingdom—that of Glasgow—is carried out under distinctly separate managements, and by works which have nothing in common with each other. On the other hand, equally important systems, such as Manchester and Liverpool, are being carried out on contrary methods. It is urged by opponents of combined stations that the tramway system is too important to tack on to a lighting system; but it seems to us that if the electric lighting of any town is properly developed the demand for current for this purpose may be greatly in excess of that required for merely tramway purposes. Moreover, the development of electricity works is in the direction of supplying energy for motors, and in some cases where this has been done signal success has been achieved. Tramway service has much in common with electric motors used for industrial purposes; there is the same proportional fluctuation in the demand, the question of the motor load and lighting load overlapping arise in the same way, and if these difficulties can be successfully met under such conditions, we do not see why the peculiar demand necessary to operate the tramway service should not be equally successfully met. From a municipal point of view, it may be desirable that the management of the tramway system should be distinct from that of electric lighting works; but the most reasonable arrangement would be for the tramways to be managed by a special tramway committee, the lighting committee being responsible, as far as the tramways are concerned, for merely supplying electrical energy. Following on the same lines, it would appear that the electrical engineer should be responsible for the supply of energy and for the supervision of the electrical details of the tramway. The advocates of combined systems have hardly gone beyond that, and it is to be sincerely hoped that



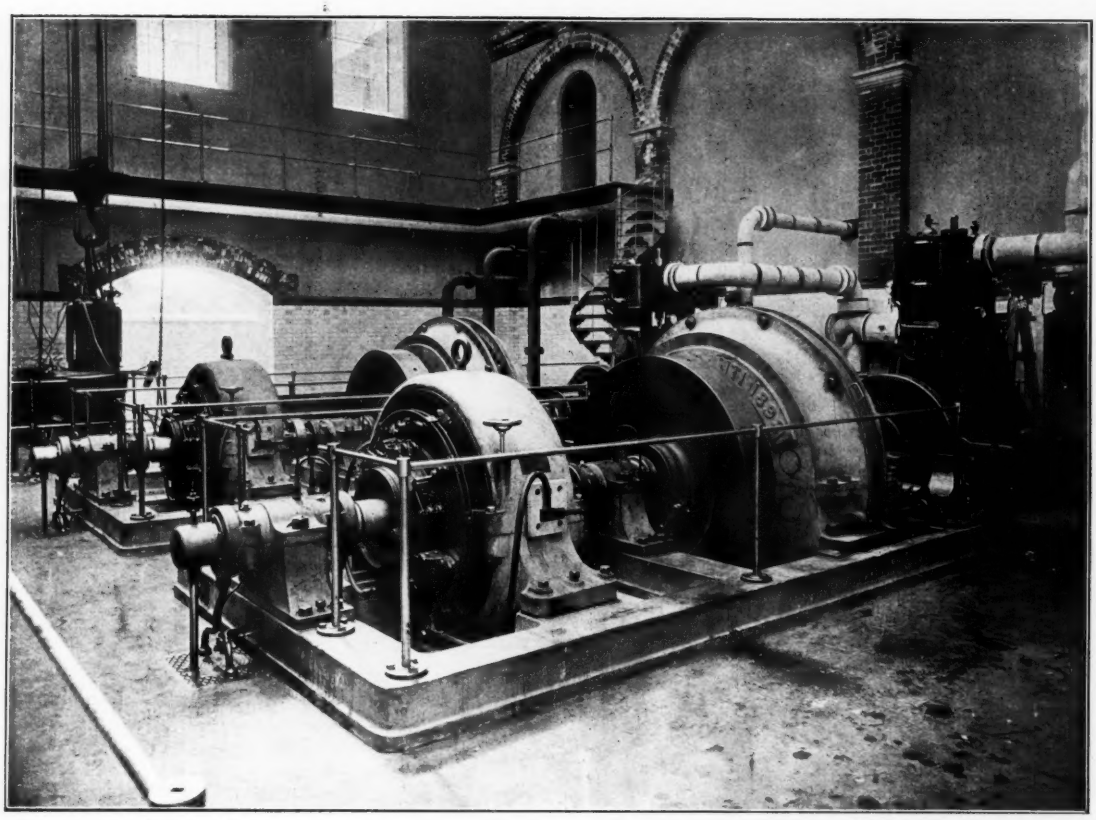
General View of Engine Room.

the development of municipal tramways will be carried out on somewhat similar lines. We admit that there may be some difficulties in allocating the expenses of generation and distribution, but they are not insurmountable. One important fact is that when a municipality is undertaking electricity supply services (and as they ostensibly work for the common good) no possible harm can accrue from generating electricity for both purposes in one works, assuming the location of the station to be equally good for each.

The Plymouth system, as we have said, is not remarkable for its size, but it possesses, nevertheless, some distinctly interesting details, not only in the arrangement of the generating plant, but also on the tramway side of the undertaking. The lighting of the town is carried out by alternating current machinery, and the necessity of adopting that system has led to a novel arrangement of machinery to which we will refer subsequently. Considerable delay has arisen in starting the works, but the delay has been created through difficulties of the most exceptional character. The site for the works is on the banks of the Cattewater, in close proximity to the famous Prince Rock. The difficulties alluded to arose in making the foundations for the buildings, every single foot of ground being of solid rock and necessitating extensive blasting operations. The station is about 1½ miles from the centre of supply, the building being of plain and substantial structure most conveniently situated both for coal and water. As we have already indicated, the works abuts on the Cattewater, and in addition to enjoying facilities for receiving coal by water, it is connected to the London and South-Western Railway system, a siding in fact being just outside the works.

In a general way the coal for the works will be delivered at the wharf by boat, it being possible for fairly heavy colliers to come alongside. It is the intention of the engineer to erect an automatic coal conveyor, which will carry coal from the wharf to the stores; the latter are arranged in proximity to the boiler house, coal being fed to the boilers by means of shoots and mechanical stokers. The coal will be delivered into the wharf stores, which will have considerable storage capacity, the rest of the operation being carried out by the conveyor. Sea water from the Cattewater is used for condensing purposes, the water from the Corporation mains being used for the boilers. The town's water, by the way, is exceedingly soft, thus differing in character from the water generally obtained on the South coast.

A special advantage possessed by the present site is the ample room provided for extensions, and without the necessity of carrying out any further blasting operations, the present structure could be materially added to. The buildings, erected by Messrs. Pethick Bros., Plymouth, are arranged with the offices in front, the engine house and the boiler house being behind. The engine room is 100 feet long × 40 feet wide, and the boiler house is 100 feet long × 54 feet wide. We may emphatically state that we have seldom inspected any electricity works in this country that are better designed than those at Plymouth; the engine room is unusually lofty, the machinery is not cramped in any way, and the switchboard arrangements have been exceedingly well thought out. Moreover, the office portion has been designed in no niggardly spirit, the staff being well provided for both in the way of office and mess accommodation.



General View of Engine Room.]

The steam raising plant at the present moment in use, for which Messrs. Musgrave & Sons, Ltd., are responsible, comprises three Lancashire boilers, each of which will develop steam for 350 I.H.P. They are 30 feet long and 7 feet 6 inches in diameter, and have each 3 feet furnaces. Vicars' mechanical stokers are fitted to each boiler, and are driven by means of an electric motor, the same motor being also employed for driving the Green's economiser. As we have already indicated, the coal is fed from the store, which is carried over the length and breadth of the stoking floor. The water is fed to the boilers by means of Hayward Tyler's three-throw ram pumps, which are driven by electric motors. These pumps draw water from a storage tank, which is placed on the top of the coal store, having a capacity of 28,000 gallons of

water. It may been mentioned that over the coal store two tanks have been erected, one for the condensing water, and the other for the boiler feed water. Each tank measures 30 feet long by 25 feet wide, and is about 7 feet deep inside. They are built up of cast-iron flanged plates, and access to the tank floor is obtained by means of a ladder leading from the coal store. In addition to the three pumps there is also provided a Gresham's self-acting injector which is capable of delivering 4,400 gallons of water per hour, against a steam pressure of 130 lbs. per square inch. An economiser consisting of 256 pipes arranged in two blocks, each eight pipes wide, has been provided, and is of the latest type, complete with deflectors, scrapers, and gearing. The steam piping is exceedingly well arranged and is probably one of the most interesting features of the works. It is of lap-welded wrought-steel with wrought-iron flanges secured and brazed on, the bends being of solid drawn copper with flanges of the same material brazed on. The piping is so arranged that while, generally speaking, each boiler feeds its own engine, it is possible to cut out any boiler and obtain steam from the others. This arrangement is carried out by means of an auxiliary main passing along the back of the boilers with a T junction to each of the mains from the boiler to its engine. It is evident, from an inspection, that the design permits of a short length of pipe, and, moreover, gives the necessary duplication. Hopkinson fittings are used throughout the steam piping. Korting ejector condensers are employed and are placed under the engine house. The condensing water is carried from the Cattewater through the inlet pipe, which is pushed forward into the stream, and from thence passes under the roadway in a trench. There are three centrifugal pumps of the Gwynne type having 6-inch suction and discharge pipes. They are driven by motors of the Electric Construction Company's manufacture. The whole steam, exhaust and other pipes are covered by magnesia non-conducting material, and an arrangement has been adopted which materially adds to the appearance of the boiler house, and may possibly affect the efficiency to some extent. The whole of the boilers and the top of the economiser are covered by a floor upon which is laid magnesia covering to a depth of about 3 inches; this undoubtedly permits of easy inspection and operation of fittings and valves, and guards to some extent against radiation losses.

Car on Line.

Coming now to the engine room plant, the machines that merit first consideration are the combined plants. They have been termed steam dynamo alternators, and as will be seen from the illustrations, they consist of an engine driving an alternator and a continuous current dynamo arranged in line on a shaft, the whole of the plant being upon a combination or coupled bed-plate. There are two of these sets; the steam engines are made by Messrs. Belliss and Co., of the enclosed vertical type to run with two cylinders arranged for compound working, and capable of giving off continuously 150 B.H.P. The alternator is placed between the engine and the continuous current machine, and the functions performed by these machines render necessary a special arrangement of clutching devices. Mr. Rider, in advising this combination, has had in mind a combination of arrangements which he suggested some time ago, viz.:—

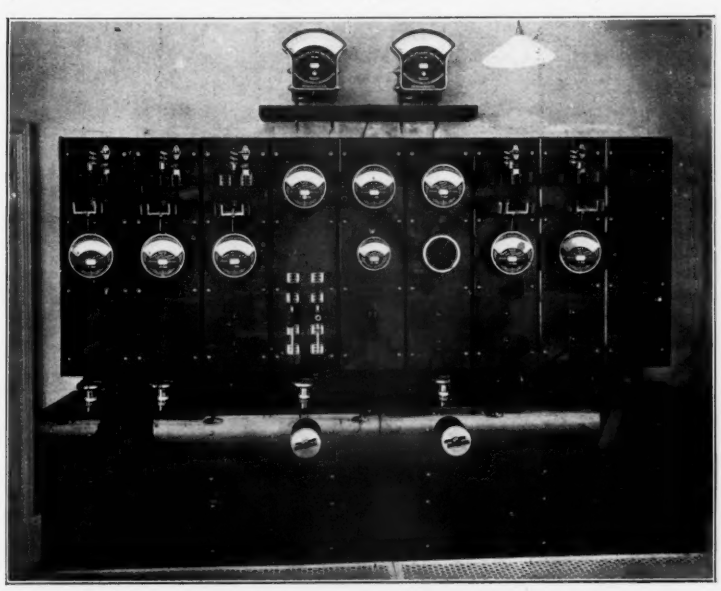
(*a*) Engine driving both alternator and dynamo, one for lighting and the other for traction.

(*b*) Using the plant for tramway work alone; that is, the alternator being uncoupled.

(*c*) For lighting work only, the continuous current dynamo being uncoupled.

(*d*) The engine being uncoupled, and the machine running as motor-generator for traction, the current in this case being obtained from bus bars to work the alternator as a motor.

(*e*) Engine uncoupled, machine running as motor-generator for lighting, in this case the continuous current machine is driven by the accumulators.



Traction Switchboard.

A consideration of these will show the great variety of functions that can be carried out by this plant. It may be said, however, that the success of the arrangement depends entirely upon the clutching devices, for the question of efficiency when the engine is driving only one machine can be left out of account. The type of clutch adopted is of the Lindsay coil pattern, and may be said to be a steel spring held at one end and coiled round a chilled iron sleeve, the other end being free and twisted over. To meet any

irregularities of drive, the clutch is made double, and each part will work in either direction, so that in the event of one portion of the combination running somewhat out of step one-half of the clutch would be always working right. When using this plant as a motor the usual method is to run the engine up to speed, and when the dynamo is excited the engine can be thrown out of gear. The alternator in this combination plant is of the well-known Ferranti pattern, while the continuous current machine is of the Westinghouse railway generator type. It is of multipolar pattern, and consists of a circular yoke carrying inwardly projecting pole pieces of laminated soft steel. The fields are split horizontally, which permits of ready inspection of armature or field coils. These generators are usually built over-compounded, so that the potential at the terminals increases about 10 per cent. from no load to full load. The shunt and series coils are separately wound and readily removed, the series coils being composed of forged copper conductors of rectangular section. The armature core is made up of punched sheets of steel. This core is built upon an iron spider, which also carries a commutator. The spider is pressed and keyed upon the engine shaft, and may be drawn off at will. Ventilating spaces through the spider and armature cores are so arranged as to allow a constant circulation of air through the commutator and windings when the machine is running. The periphery is slotted and the armature windings are made from bars of drawn copper forged into proper shape on cast-iron formers. After being thus shaped, the bars are thoroughly insulated with mica and prepared and baked to remove moisture. The coils are held in the slots by means of retaining wedges of hard fibre driven into notches near the top of the slots longitudinally with the armature. These fibre wedges are pressed out at will should it be necessary to remove any armature coil. The commutators are of hard-drawn copper, the segments being built up with prepared mica of corresponding hardness. The brush holders are carried on brackets projecting from a ring concentric with and supported by the field. A hand-wheel rocker arrangement gives the necessary adjustment.

Lighting Switchboard.

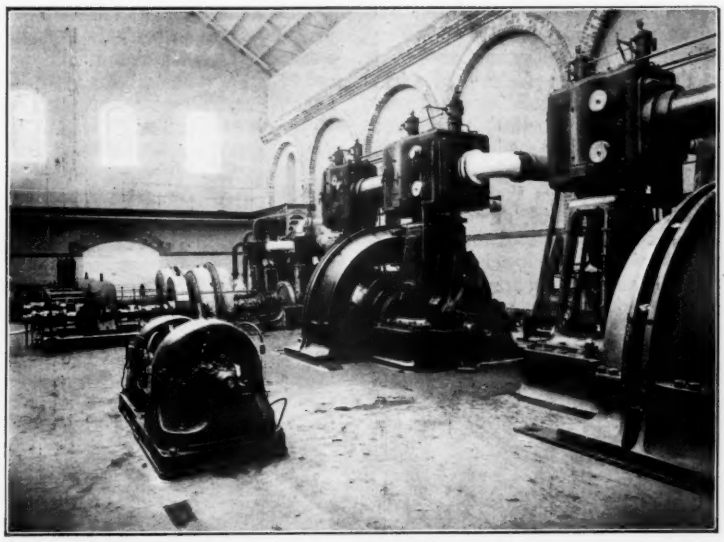
The other generating plant in the station consists of steam direct-driven alternators. Both the engines and alternators have been constructed by Messrs. Ferranti, and each set is capable of developing 200 KW. The engines are of the compound condensing type, and each set is built on a special foundation bed. The fly-wheel is placed between the cylinders, and carries the revolving part of the alternator. The working parts of the engine are accessible, but when working are enclosed; the lubrication is effected entirely by force pumps which draw oil from reservoirs and deliver it under pressure to the various bearing surfaces. For street lighting there are three Ferranti rectifiers of the latest type. The generating plant is completed by a motor-generator capable of developing 150 amperes at 133 volts, the motor being supplied with current at about 500 volts pressure. There are three switchboards, two of which, the lighting and tramway boards, are arranged in a special gallery, while one, the rectifier board, is placed on the engine room level. The lighting board is of the well-known Ferranti pattern which has been often described in these columns. A few feet away, on the same gallery, is the tramway board which is supplied and equipped by the Westinghouse Company. The principle of this board does not differ materially from those usually employed in tramway works. It is divided into panels for feeders and for the Board of Trade instruments.

The battery consists of 260 cells, supplied by the Tudor Company; the capacity of each cell is 620 amper-hours at 120 amperes, with a maximum discharge rate of 200 amperes.

The outside work divides itself into two portions, the street lighting and the tramways. Before speaking of this, however, we would point out that the distribution of electricity for private lighting is done by means of transformers placed in chambers built under the footpaths in different parts of the town, access to these being obtained by means of an iron ladder. As a rule four 25-KW. transformers, transforming down from 2,000 to 200 volts, are placed in each chamber. The transformers have been constructed by the Ediswan Company, and of those supplied eight are for 25 KW., each weighing over 1 ton. The terminal fittings of these are mounted on separate porcelain slabs, the secondary connection being arranged for use on a three-wire system, so that 200 or 100 volts can be obtained. The sweating sockets are specially designed and arranged to pass readily through the glands, and are no larger in diameter than the insulated cable. Other types of Ediswan transformer have been furnished, one in particular being for 1,000 volts and 2 amperes. Another has been supplied for meter testing, and is arranged with a secondary sub-divided in such a way that any pressure between 90 and 200 volts can be readily obtained. The whole of the mains have been made by the British Insulated Wire Company, but all the work in connection with the laying has been carried out by the Corporation under the direct supervision of Mr. Rider. The high tension mains are composed of $\frac{7}{14}$ and $\frac{9}{15}$ concentric, which are insulated with paper, lead covered and juted, and compounded over the lead, drawn into Doulton earthenware conduits. The low tension cables are

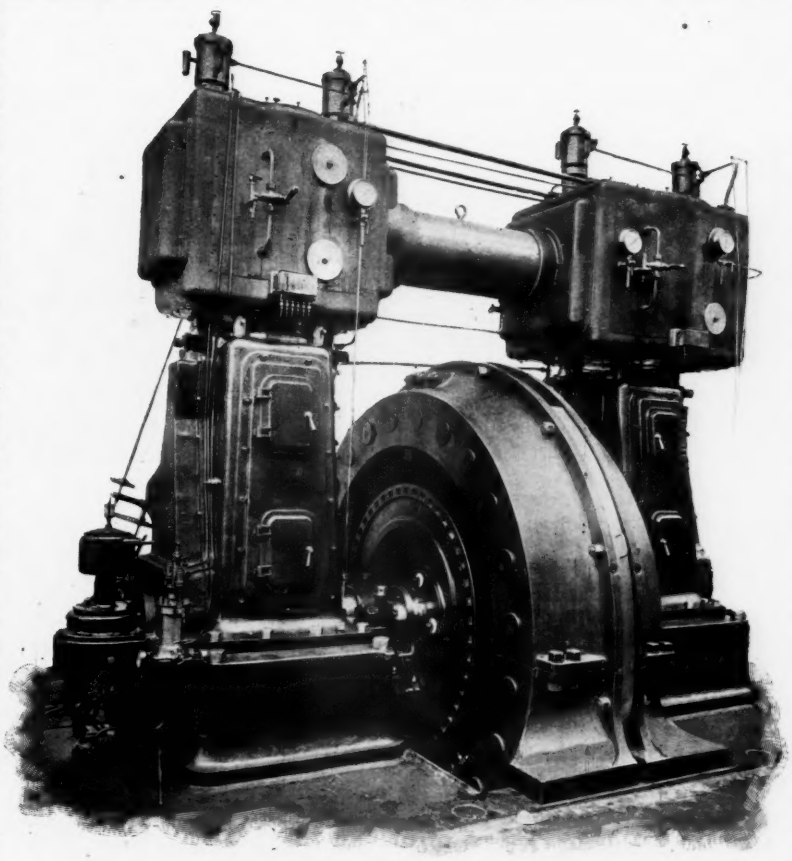
·150-inch, ·20-inch, and ·250-inch triple concentric. These are armoured, and have been laid direct without further protection, as was also the tramway feeder, which is composed of ·150-inch single cable.

The arc lighting cable consists of $\frac{7}{16}$ S.W.G. twin paper insulated lead-covered and armoured, laid direct in the same way as the triple cable, single rubber cables being used between the arc service boxes and the lamps themselves. It is worth mentioning that the service boxes of the arc lamps where they are suspended to the tramway poles, are placed under the foot-path instead of being fixed under the base of the lamp column.



View of Engine Room.

The house service cables are generally composed of $\frac{19}{14}$ and $\frac{19}{16}$. These are concentric and laid direct, the service being connected by means of triple concentric service boxes, with wiped glands, the service terminals being connected by means of fuses to the main terminals. It will be readily understood from what has been said that arc lighting forms a conspicuous feature in the scheme which has been completed. As a matter of fact, there are at the present moment some 74 lamps erected, 13 of which are on the Hoe. As far as possible tramway poles have been utilised, but where the arc lighting is carried out in streets where tramways do not exist, separate poles of a special design are employed. A word of praise ought to be awarded to the designer of the scroll work carried on the top of the poles, and it is gratifying to find that the designs have been originated in the borough electrical engineer's office, Mr. E. G. O'Kell, the chief assistant engineer to Mr. Rider, being responsible for them.



Single Alternating Set.

The pillars are of two kinds—(*a*) cast-iron throughout, and (*b*) tubular steel, with cast-iron mountings. There are 48 cast-iron posts and 30 tubular posts; 28 of the lamps are suspended from wrought and cast-iron brackets, and 50 are fixed in ornamental canopies. The tubular posts are also used for carrying the span wires for the tramway overhead conductors.

The lamps are of the well-known Crompton-Pochin type. They are arranged to burn with a rectified current of 10 amperes. They are double carbon and burn for not less than 32 hours without re-trimming. Each lamp is provided with an internal automatic cut-out to short circuit the lamp in the event of any accident to the mechanism. Each lamp is also provided with an isolating switch, which enables the lamp to be entirely disconnected from the mains and the two cables leading into the post to be connected together. With this arrangement it is possible to re-trim a lamp while the current is on, without any danger to the attendant and without in any way interfering with the remainder of the circuit. In the case of the cast-iron posts, these switches are fixed in the base. In the case of the tubular posts the switches are in water-tight cast-iron boxes under the pavement.

The lamps are run in two circuits off Ferranti rectifiers, each rectifier being capable of supplying current to a circuit of 50 lamps in series.

The whole of the street lighting work, including the erection of the lamps, poles, &c., and the coupling up, has been carried out by Messrs. Crompton & Co., Ltd., of Chelmsford and London.

It is necessary now to refer to the tramway portion of the undertaking, and though the work for the most part is similar in character to the work carried out on other systems, still there are details which might be referred to with advantage. The track which has been specially constructed for electrical operations extends from the Prince Rock to the Royal Theatre in the centre of the town. The line is double throughout and has a gauge of 3 feet 6 inches, the rails being of the girder type, and weighing 92 lbs. per yard.

They are heavily bonded together, three Chicago bonds being employed in place of the two usually adopted. Messrs. Askham Bros. & Wilson, Limited, supplied a quantity of material in the shape of their patent crucible cast-steel points and crossings, together with their patent joint plates with lock nuts. Mr. Rider is a believer in the swivelling trolley, and it is interesting to observe how he has utilised the undoubted advantages of a revolving trolley head in arranging the overhead wires. Practically every form of overhead suspension is employed, side suspension from single arm brackets, centre poles, suspension from buildings, and suspension from posts and buildings. But a method is employed which we believe has not been previously adopted in this country, it is the suspension of wires on each side of the road. Obviously this is more expensive than employing single arm brackets, it being understood, of course, that central poles are not permissible, but the advantage of a wire being carried on each side of the road is that it needs short arm brackets. It will be seen from the photographs that this method has much to commend it, and is unquestionably an improvement upon the long arm brackets, which are becoming so marked and disagreeable a feature of much of the overhead construction at present in vogue. The wire is of 000 gauge, guard wires being employed practically throughout the system. The tramway poles are

Plymouth.—Street Scenes.

of two kinds—they are all of cast-steel; but while some are made in three sections, others have been made in a single section. The engineer, in specifying for the posts, insisted upon an exceedingly rigid test; they were to withstand being dropped three times (butt end foremost) from a height of 6 feet on to a solid substance, and as a bending test they were laid horizontally from a support 5 feet 6 inches from the butt end, and loaded at a distance of 18 inches from the top end with a weight of 700 lbs. The temporary deflection was not to exceed 6 inches. The line is divided into half-mile sections, a junction box being placed at each half mile. Instead, however, of taking the form of a pillar placed at the edge of the kerb, Mr. Rider has adopted a plan which is worth noting; the box, as a matter of fact, is sunk into the wall. The door of the box is flush with the service wall, and looks not unlike a safe. It should be mentioned, however, that both section boxes are on Corporation property, and it is doubtful whether private owners would generally permit of a box being sunk into their property. The rolling stock is not very extensive at present, and consists of only six cars, each of which will carry 42 passengers, 20 inside and 22 outside. The bodies have been constructed by Messrs. Milnes & Co., and are carried on Peckham cantilever trucks. Westinghouse equipment is used on the cars; there are two motors, and the usual controlling devices—emergency switches, electric brakes, &c. The electric braking arrangements are similar to those employed on other lines using Westinghouse equipment. For braking purposes the motors work on a closed circuit, which is varied gradually, the operation, of course, being independent of current from the trolley line. The cars are lighted with electricity in the usual way. Our thanks are due to Mr. J. H. Rider for the courtesy shown to our representative on the occasion of his visit.

## 2,000-H.P. ENGINES.

The largest factory engines ever made were constructed, we believe, for a Bombay cotton mill by Messrs. Hick Hargreaves and Co., of Bolton. They were of some 4,000 H.P. Marine engines of 30,000 H.P. have been made for Atlantic liners, but, unless the increase has been recent, the maximum power put through any one crank is 5,000, and this figure was reached many years ago in the *Britannic*. In the early days of electricity there was a tendency towards over confidence. This tendency was exhibited by the intention to put down a 10,000-H.P. engine at Deptford. The engine, to use an Americanism, did not materialise, at least, not wholly, though a very large shaft was on sale at Deptford. A pair of 1,500-H.P. engines were, for a time, spoken of as the little engines in pleasing anticipation of joys to come in the shape of the large engine which never came. The attempt to do too much at once, to take too big a step, has probably had much to do with the niggling manner in which the steam engineering of central stations has since been carried on. The fact that 10,000-H.P. engines failed to be completed, was probably due to a financial, not an engineering, cause, and was no warrant for other stations employing a hundred little engines on the same duty.

Since the days of big things, however, Deptford has gone steadily, and the new engines called for some time ago have been some months at work, and are now described in the *Engineer*, from which we gather a few of the principal dimensions and figures. Made by Messrs. Plenty & Son, Limited, of Newbury, they are of 2,000 H.P., with three

cranks and six cylinders in vertical tandem pairs. The engines are by no means of large size though of a considerable collective power. The high pressure cylinders are 19½ inches diameter, the low pressure cylinders are 43 inches, and the stroke is 26 inches. The speed is 156 revolutions per minute, and the initial pressure 140 lbs. The Siemens-Martin steel shaft is 12 inches diameter in both main bearings and crank pins. The valves of each pair of cylinders are worked by one eccentric, the high pressure valves being of piston type and the low pressure valves of flat or D type. The details are not clearly shown, but seem to indicate too small a valve chest to the low pressure cylinder and somewhat cramped valves. The marine type has generally been followed except that they exhaust to independent condensing plant. The generator driven by these engines is a direct coupled Ferranti alternator, having an output of 150 amperes at 10,000 volts. A test load of 300 amperes has been run and 15,000 volts have been put on the insulation generally, though some of the details were put to more severe tests; for instance, the pole caps of micanite have been tested to 21,000, these magnet pole caps having been the chief offenders years ago in the early failures of 10,000-volt machines.

The *Engineer* states that the latest Deptford machine was finished one day, tested for pressure the next day, for current the third day, and on the fourth day was put on the mains at 10,700 volts at a load of 125 to 140 amperes, and has so been at work half a year. Why, therefore, should other companies go to America for 500-volt plant and costly upstep transformers, when they might manufacture the full pressure at once? At Deptford the "low pressure" plant at 2,500 volts is to be scrapped. The armature, which weighs 38 tons, has 64 bobbins, with cores of laminated brass and asbestos. They are bolted to the wheel with the above-named micanite cap insulation. They are wound with copper corrugated tape, and insulated with silk and vulcanised fibre. Pump lubrication at 15 to 20 lbs. pressure is carried throughout the shaft bearings. The armature shaft is coupled to the engine shaft, and the bedplates are connected into one rigid whole. Current is collected by three brushes from a split ring fixed on the wheel, on the side away from the engines. The field magnets number 128, one on each side of the armature bobbins. Their pitch circle is 20 feet diameter, and the peripheral speed is over 10,000 feet per minute. The field coils are of solid rectangular copper strip. A good deal is made of the three cranks, and five are prophesied. Now three cranks are convenient, but even in a three-crank engine, arranged as at Deptford, all the work has to go through one main bearing, and two of the cranks are too large for their work. In a five-crank engine, probably three of the cranks will be too large, if not four, and an extension in the line indicated is of doubtful value and very problematical economy.

The engines illustrated by our contemporary are open to some criticism. It is extremely bad practice to make the H.P. piston, or, indeed, any piston of a vertical engine with a recessed water-holding upper side. Perhaps we ought to forgive the conical form, though this is avoidable, but if the piston must be conical, it should cone from the cylinder, and not be made water-holding. Then the exposed inner surface of cylinder and cover and piston is enormous. The H.P. piston rod is shown fluted circumferentially, so that it closely resembles a square-threaded screw. Between the two cylinders there is no stuffing box but merely a long sleeve through which works the fluted rod. No explanation of this is afforded though the idea appears good. The cylinders are well drained at their lower ends, but as above stated, are badly provided with drainage above the pistons. The bracket carrying the rocking lever of the high pressure valves is shown as one piece with the top cover of the high pressure valve chest. This is hardly good practice, either for the valve motion pins and bearings, already numerous enough, or for the faced joint of the valve chest cover, which, however, it is only fair to say, covers the exhaust end of the chest.

Plymouth.—Street Scenes.

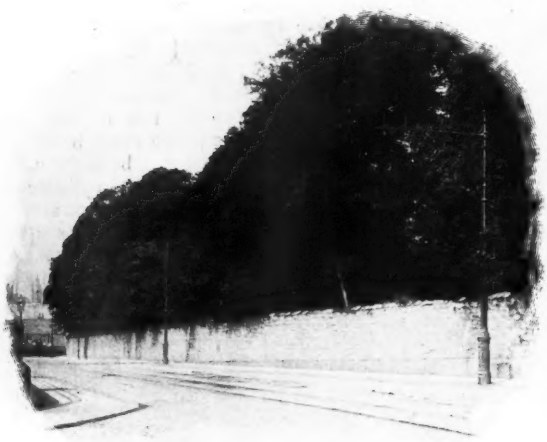
## ELECTRIC TRAMWAY SYSTEMS AND FREIGHT DISTRIBUTION.

In a recent issue (see Electrical Review for June 9th) we referred to the use of the tramway system in Brooklyn for freight purposes, and we discussed the future prospects of this development of electric traction. Since that date we have come across two facts of interest in connection with this subject.

In the issue of an esteemed contemporary for March 18th last, there is a description of a specially designed meat-car for

use upon the electric tram system of Buenos Ayres—a city of 850,000 inhabitants.

Owing to the excessive heat, a rapid distribution of the meat killed at the public abattoirs is most desirable. The



Plymouth.—Street Scene.

municipal authorities have therefore taken the matter in hand, and have arranged with the tramway company for a special service of these meat-trolley-cars, to be run between the hours of two and nine in the morning for conveyance of the meat from the abattoirs to the various retail establishments of the city.

The second fact relates to the suggestion, made in our last note on this subject, to the effect that a cart or car which could be run either on the ordinary road, or on the tramlines, was required, before the electric tramway system could be widely utilised for freight distribution during the early morning hours.

A car has been designed by Messrs. Siemens & Halske, of Berlin, for use on either the ordinary roads or on the tramway lines within that city. When running on the ordinary road, it is worked by an electric motor, and draws its power from a storage battery; when on the tramway lines the motor is driven from the overhead conductor by means of a trolley apparatus, and is kept upon the track by means of two pairs of guide wheels, which can be raised and lowered at will. The storage batteries can be re-charged when the car is running on the tramlines by means of a second trolley pole and apparatus.

This car is intended only for passengers, and it has been successfully run in the streets of Berlin, but it is evident that the utilisation of such cars could be widely extended, and that *if economical in operation* they might be used to distribute every kind of freight and merchandise within the area of the larger towns and cities.

## ARRANGEMENTS OF STEAM PIPES.

Mr. Edgcome's paper on steam pipes, read before the Municipal Electrical Association and reprinted on another page in this issue, is written from the point of view of a man who believes in ring mains. To our mind the ring main is a contrivance for providing for breakdowns which would not occur if there were no ring main. As we reproduce the paper in order to let the views of the ring main have fair treatment, it will be seen what a lot of complicated drainage the author thinks necessary to provide. He would have a station full of steam traps and drain pipes. We do not follow the author's reasoning as to the isolating valve and its functions. This valve does not enable a boiler to recover itself in the manner described, but it does prevent a boiler from acting as a condenser, and from swallowing up steam from more active boilers, and it is an admirable safeguard when men are at work inside a laid-off boiler, for it prevents the disastrous effects which follow the accidental opening of the junction valve whereby men may be injured. We rather object to his remarks anent the use of safety keys for blow-out taps. The keys he describes are excellent as a preventive against accidental leaving open of a blow-out tap, for the key cannot be removed until the tap is closed. So far, good. But there is always the chance of there being duplicate keys. Spare keys may be kept under lock and key, but some day a second key will get into the boiler room. Perhaps one key is lost. A second is procured. The first is found again. There are now two keys, and this is sure to be the moment selected for a man to be coming out of an empty boiler. A working boiler is blown off into the common waste pipe, and the man in the empty boiler or half out of the mud-hole is endangered. The lesson is, avoid common waste pipes. Carry each boiler blow-out by its separate waste pipe, so that there cannot be a back flux; but do not trust to special keys except as a safeguard against a collapsed furnace, for which they are admirable. The author points out the danger, but considers locking up of the spare keys is sufficient safeguard. He is mistaken. He is wrong in advising the making of stringent rules against other usages which ought not to be capable of causing the dangers against which the stringent rules are needed. Good design of a boiler plant should avoid the necessity of stringent rules which are always forgotten just when their observance would lead to safety.

If Mr. Edgcome had ever been inside a boiler when it had been blown into from a common blow-out waste, he would

Plymouth.—Lamp-post.

have had less to say of stringent rules, and more to say of the faults which render such rules necessary. The common waste pipe is one of these faults. It may be usual practice. This does not justify it.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page 232.*)

**Middleton.**—Last week the Council passed a resolution to make application to the Board of Trade for powers to construct tramways from Middleton to the Manchester boundary. Middleton is laying the lines, but the service will be supplied by the Manchester Corporation, with whom an understanding has been arrived at. It was also decided to make application to the Local Government Board for borrowing powers for a further sum of £4,500 for electric lighting purposes.

**Newcastle.**—At a meeting of the Tramways Committee on August 1st, it was reported that Prof. Kennedy was not prepared to recommend the laying down of a conduit or any intermediate service in the city in connection with the overhead trolleys from outside, but preferred to await developments. There was a suggestion, however, that centre poles be fixed throughout the main streets, as a temporary arrangement, and when practical experience showed a better system these could be removed. It was agreed to recommend the Council to instruct the engineer to advertise for tenders for rails for the permanent way, boilers for the power station, &c., in order that that portion of the work might be proceeded with.

**Oldham.**—The Surveyor's and Tramways Committee's chairman, Ald. Eckersley, the surveyor (Mr. Pickering), and the electrical engineer (Mr. Newington), recently had an interview with Mr. Alderman Higginbottom, of Manchester, regarding the tramways. Reports respecting the interview were read at a meeting of the committee on Thursday last week. Mr. Pickering said that Alderman Higginbottom did not believe in calling in experts. He did not see why Oldham should not do the same as Manchester, and rely upon its own electrical engineers. He expressed the hope that his Corporation would eventually come to a reciprocity agreement with Oldham for the through service of cars between Manchester and Oldham. Alderman Eckersley's report states that, after the interview, he (Ald. Eckersley) was of opinion that the committee had decided to recommend to the Council the system best adapted to Oldham, and he was more decidedly so when they took into account that they would be more thoroughly able to work their own system in conjunction with Manchester and Rochdale by agreement, as he hoped, to the mutual advantage of all three municipalities. Mr. Higginbottom gave an invitation to visit the Manchester Electricity Works, and he (Alderman Eckersley) thought much good might result to the committee by doing so, and to the Electrical Committee also. He hoped now that the committee would bend its energies to the carrying on and completion of this great scheme.

**Peking.**—The *Westminster Gazette* learns from the *North China Daily News* that the first electric tramway in China was opened on Saturday, June 24th, between the Peking station at Machiapu and the south gate of the metropolis Yung ting-men. The whole system works excellently. The tramway was projected and constructed by Messrs. Siemens & Halske, of Berlin. It is intended to extend the tramway inside the city, a great difficulty being to break a new gate for the line through the city walls; but after all it will only be a question of time, it being an urgent necessity to have a better communication between the Peking station and the city. "Why should London wait?" asks our green contemporary, forgetting that its own party on the London County Council has been responsible for the delay in London.

**Portsmouth.**—At a meeting of the Town Council, on August 8th, the Tramways Committee submitted the names of three candidates for the post of superintendent of the reconstruction of the tramways, viz, Messrs. Alan Bannister, of Norwich; E. Rotters, of Seton, Kerr & Co., and F. Smith, of Coventry. The recommendation of the committee that Mr. Bannister be appointed at a salary of £400 per annum, rising to £500, was unanimously adopted. The committee was authorised to invite tenders and to obtain such assistance as might be necessary for carrying out the work.

**Rotherham.**—The Town Council has appointed a Parliamentary Committee to consider and report on a proposed omnibus bill, dealing with, amongst other matters, a scheme of electric traction.

**Stockton.**—At a meeting of the Tramways Committee of the Corporation, held last week, Mr. J. Clifton Robinson announced that the Imperial Tramways Company had decided to abandon the extension of the Teeside system to Eaglescliffe for various reasons, the chief being that the requirements of the local authorities were of a too exacting nature.

**Stretford.**—A meeting of the Electric Lighting and Tramways Committee was held on the 25th ult., at which a letter was read from the United Kingdom Tramway, Light Railway, and Electrical Syndicate, Limited, requesting permission to open negotiations with the Council with a view to the construction of a light railway through the township as part of a scheme comprising the districts of Urmston, Eccles, Farnworth, Radcliffe, and Prestwich. The company asked for a concession of 42 years, and offered to equally divide all profits after they had realised 7½ per cent. The committee resolved that they were unable at present to entertain the proposal. At the same meeting a letter was read from Messrs. Crofton, Craven & Worthington, intimating that the Manchester Ship Canal Company had given notice to the Board of Trade objecting to their granting an extension of time for the construction of the Trafford Road line. The committee resolved that the Manchester Carriage and Tramways Company be requested to at once construct, in a manner suitable for electric traction, that portion of the tramline in Trafford Road authorised by the company's provisional order of 1897. The minutes were adopted. Mr. Robinson stated the position of the Council with regard to the Port Sanitary Authority. In a scheme which it had put forward, the Authority sought to make each district protected liable to pay the expenses properly chargeable to it. The scheme was only tentative, but its reasonableness was admitted. An inquiry was to be held by the Local Government Board, the result of which would be to confirm the arrangements made, and to renew the order for a further period.

**West Bromwich.**—The Council has decided to promote a Bill in Parliament to purchase, maintain, work or lease that portion of the South Staffordshire tramway which is within the borough. The object of the step is chiefly to strengthen the position of the Council in negotiations with the Tramway Company.

**West Hartlepool.**—The British Electric Traction Company has given notice of its intention to proceed with the light railway from Church Street to Seaton Carew.

**Wolverhampton.**—The Lighting Committee has concluded an agreement with Messrs. Chubb & Sons, for the supply of electricity to their factory at 4d. per unit for lighting and 1½d. per unit for motive power for a term of five years.

## TELEGRAPH AND TELEPHONE NOTES.

**The "All-British" Cables.**—A Melbourne telegram, dated the 4th current, says that Mr. Duffy, Postmaster-General of Victoria, has given notice that he will move that it is expedient for Victoria to join Great Britain, Canada, New South Wales, Queensland and New Zealand in the construction and working of a Pacific cable touching British territory only.

An electrical contemporary, in referring to the cables which the Eastern group of companies propose to lay from the Cape to Australia, says: "As the West African route is not a strong one and is more or less at the mercy of the French Colonies, while the East Coast cable goes, of course, to the Mediterranean, like the rest, the proposal will hardly commend itself as a substitute for the Pacific cable."

In the House of Commons, on Monday last, Mr. Hogan asked the Secretary for the Colonies whether he had received any further information in reference to the settlement of the remaining points at issue in connection with the construction of the Pacific cable; and whether the negotiations had now sufficiently advanced to enable him to give a general outline of the amended scheme of joint ownership and mutual responsibility, as agreed upon by the representatives of Her Majesty's Government and the Colonial Governments concerned.—Mr. Chamberlain replied: The terms of the arrangement are not yet completely settled, and I am not in a position to make any statement.

A writer in the *Moniteur Universel*, in reference to the Pacific cable, says that the matter is one of life or death to the French possessions in the Pacific. He calls on France to come to an agreement with the United States for the laying of a cable from San Francisco to New Caledonia, with a view to forestalling the British project, being of opinion that were this done the proposal for a Canadian cable would be abandoned.

**The City Police and the Telephone.**—After an extraordinary amount of delay, says the *City Press*, the headquarters of the City police force have been connected with the National Telephone Company's system.

**Hull Telephones.**—At the last Council meeting a motion was considered for giving notice to the National Telephone Company to terminate the agreement as to the wayleaves in the city. A deputation attended, consisting of Sir Albert Rollit, M.P., Alderman Franklin, of Sheffield, and the general manager of the Telephone Company. Alderman Sir J. T. Woodhouse, M.P., said this was a very serious matter, not only for Hull but for the National Telephone Company. The Bill now before the House of Lords was on the point of being passed, and it was essential that they should place themselves in a safe position by giving the Telephone Company notice. Alderman Larard then reviewed the steps taken by the National Telephone Company in connection with the bill now before Parliament. If it passed they would be placed in a very serious position unless they gave the notice which he had placed upon the paper. If the bill passed as it stood, and it was very likely so to pass, then they would lose control to some extent of their streets until 1911. That was a state of things the Council ought to resist, and he therefore gave notice of motion that the agreement as to wayleaves with the National Telephone Company should be terminated in six months. He moved his resolution with the hope that it would be unanimously carried. Mr. Gane, the general manager of the National Telephone Company, stated that the Corporation could, according to the agreement, terminate it on giving six months' notice, and the position of the Council would never be affected unless they determined to become competitors with the National Telephone Company. That company was spending thousands of pounds in Hull, and they had recently entered into a contract to spend more thousands, but if the resolution was passed they as a company would not spend another

farthing with a risk of confiscation of their property. The question was, was the Council prepared to put an end, as it were, to the telephone service in Hull, or at any rate to very seriously injure that service? As he had said, there was nothing in the agreement to affect the Corporation unless it determined to take over the telephones, and he hoped the Council would not in haste damage the telephone service in the city. The deputation then retired, and Alderman Sir James Woodhouse spoke strongly in favour of the motions, which were carried, with one dissentient.

**Melbourne Telephones.**—The *British Australasian* says that it is now fairly certain that the Postal Department will decline to comply with the request of the Ballarat sharebrokers for the erection of private telephone lines between Melbourne and Ballarat. It is likely that additional public lines to Ballarat and Geelong will be started shortly, also one to Bendigo.

**Norwich and Yarmouth Telephone Service.**—In the House of Commons on Friday, the 4th inst., Sir Harry Bullard, one of the Conservative members for Norwich, put the following question to the Secretary to the Treasury, as representing the Postmaster-General, "whether he is aware that serious inconvenience is occasioned in consequence of the insufficient trunk line telephone communication between Norwich and Great Yarmouth, and whether he will take steps to remedy the same." Mr. Hanbury, in reply, said that an additional circuit between those places was opened in March last, and at present more than 50 per cent. of the calls were effected within five minutes. The electrical working of the wires was satisfactory. The traffic, however, was growing, and the Postmaster-General had at present under consideration the provision of additional facilities.

**Questions in Parliament Regarding Various Cables.**—On Friday, the 4th, on the report of the vote to complete the sum of £71,241 for the subsidies to certain telegraph companies, Sir C. Dilke said it had been strongly rumoured lately that the companies subsidised in this vote were making an alternative route. He would like to know whether the Government could give them similar information to that laid before the Cape Parliament on the subject of the working of the lines subsidised in this vote, of the proposal for an alternative line to the Cape, of the opinions of the home Government as to the strategic importance of the proposed line, and whether, owing to the recent increase of trade in South Africa, these subsidies were necessary. He also wished to know whether the Chancellor of the Exchequer could tell them anything about the recent delays in Government messages from the Cape.

The Chancellor of the Exchequer said there had been proposals under the consideration of the Government from the telegraph companies for a new cable between this country and the Cape, touching St. Helena and Ascension. Negotiations had also been in progress between the companies and the Government of the Cape as to a considerable reduction in rates in return for a grant of land rights. He could not say the matter had approached completion, nor how far papers could be presented. But there were proposals before them which were considered of considerable strategical importance by the Admiralty as to the proposed new communications. With regard to the undue delay of Government messages from the Transvaal, he knew nothing about it, except that there was a breakdown. He knew of no other cause.

The report of the vote was agreed to.

On Monday last, in reference to the proposed cable from South Africa to Australia, Mr. Hogan asked the Secretary for the Colonies what response, if any, had been received from the Colonial Governments concerned to the offer of the Eastern Extension Company to construct a cable from South Africa to Australia.

Mr. Chamberlain said the offer in question was not made through this department. I have no information as to any replies that may have been given to the company by the Colonial Governments concerned.

On Tuesday last the following questions were asked concerning international telegrams:—Sir C. Dilke asked the Secretary of State for India whether it were possible to lay before Parliament any agreements and correspondence between the Government of India on the one side, the Eastern Telegraph Company, the Indo-European Telegraph Company, and the Eastern Extension Australasia and China Telegraph Company, or any of them on the other part, relating to the establishment or subsequent modifications of a joint-purse agreement for dealing with international telegrams and settlement of accounts between the parties to the joint-purse agreement; what was the actual cost at which the Indian Government transmitted telegrams over their lines from Karachi to Bushire and Fao; and what transit rate under the existing joint-purse system the Indian Government would charge over the same portion of their lines for messages to or from England handed to them by any British company not represented in the joint-purse agreement.

Lord C. Hamilton: It would be necessary to obtain the consent of several companies mentioned before the agreements referring to the joint-purse arrangements could be made public, and I am therefore at present unable to undertake to lay papers on the table. The transit rates over the Indian Government cables between Karachi and Bushire or Fao are as follows:—On messages exchanged with India—between Karachi and Bushire, 1·455f.; between Karachi and Fao, 1·905f.; on messages exchanged with countries beyond India—between Karachi and Bushire, 1.09f.; between Karachi and Fao, 1·39f. These rates are laid down in the International Telegraph Convention, and are the same for all classes of messages, whether handed over by any English company belonging to the joint-purse agreement or by any other company or foreign Government Administration. The rates can only be altered with the consent of the States interested who are parties to the International Telegraph Convention.

Sir C. Dilke asked the Chancellor of the Exchequer whether it was possible to lay before Parliament the agreements and correspondence between Her Majesty's Government on the one side, and the Eastern Extension, Australasia, and China Telegraph Company, and the Great Northern Telegraph Company on the other side, relating to the submarine telegraph cables which land at Wu-sung (for Shanghai), Hong-Kong, Labuan, Singapore, and Penang.

Mr. Chamberlain: The latest agreement—that of 1893—can be laid before Parliament if desired, but the earlier correspondence is not only in part of a confidential nature, but is also very voluminous, and extends over many years. I fear, therefore, that it could not be given.

Sir E. Sassoon asked the Under-Secretary for Foreign Affairs whether, in view of the agitation in this country for a reduction of foreign telegraph rates, Her Majesty's Government would request Her Majesty's Ambassador in Constantinople, Lord Cromer, and Her Majesty's Minister in Teheran to procure from the Turkish, Egyptian and Persian Governments respectively copies of all concessions granted to, and all agreements made with, either the Eastern Telegraph Company, the Indo-European, or the Telegraph Construction and Maintenance Company, or the agents of all or any of them, and the Indian Government.

Mr. Brodrick: In reply to the two questions of my hon. friend, I have to say that Her Majesty's Government would not feel justified in publishing or in obtaining for publication, as seems to be suggested, from one of the parties without the consent of the other copies of the arrangements referred to. The arrangements between Her Majesty's Government and Turkey and Persia have already been published.

**The Rennes Telegrams.**—The number of telegrams sent over the wires from Rennes on Monday night was enormous, says the *Daily Chronicle's* Paris correspondent. At the Central Post Office in the Rue de Grenelle no fewer than 200,000 words were received between 7 A.M. and 4 P.M. Five supplementary wires have been installed between Paris and Rennes, and these, in addition to the five wires in normal use, are busily employed every minute of the day.

**The Telegraph Wire Export Trade.**—There was rather a more active state of affairs prevailing in the export trade of this country in telegraphic wire and apparatus connected therewith during July last, the shipments during the month attaining a value of £97,635, which compares with only £27,817 in the preceding month and £45,600 in July last year. During the seven months ending with July, the value of the aggregate shipments has amounted to £599,308, an increase of £52,812 as compared with the corresponding period of last year, but a decrease of £7,965 when contrasted with the returns for the first seven months of 1897.

**Telegraphic Interruptions and Repairs:—**

| Cables. | Down. | Repaired. |
|---|---|---|
| Amazon Company's cable— | | |
| Cable beyond Gurupa ... | April 4th, 1898 ... | ... |
| Jamaica-Colon ... ... | June 30th, 1899 ... | ... |
| Bonny-Cameroun ... ... | May 29th, 1899 ... | ... |
| Latakia-Cyprus ... ... | June 20th, 1899 ... | ... |
| Para-Maranham ... ... | April 10th, 1899 ... | ... |
| Maranham-Ceara ... ... | July 25th, 1899 ... | ... |
| Medan-Olehleh ... ... | July 31st, 1899 ... | ... |
| Accra-Grand Bassam... ... | August 1st, 1899 ... | ... |
| Corea-Japan ... ... ... | August 7th, 1899 ... | ... |
| **Landlines.** | | |
| Communication between Salonika and Monastir ... | March 23rd, 1899 ... | ... |
| Communication between Bolama-Bissao ... ... | July 28th, 1899 ... | ... |

**The Telephone Bill.**—In the House of Lords on 3rd inst., the Duke of Norfolk moved the second reading of this Bill, the objects of which he explained. Lord Harris said he was a director of the National Telephone Company, but he approached the consideration of this Bill entirely from the point of view of a telephone user. He thought, says the *Times* report, that if the noble duke could appoint a committee of users of the telephone to report on the trunk service, which was under the control of the Post Office, it would report that that service was inefficient and insufficient; and as two millions of money were to be obtained under the Bill for the extension and improvement of the telephone service, he trusted it would be possible for the noble duke to utilise some portion of the money in improving and extending the trunk lines. In France, Germany and America it had been found that a monopoly could work the telephone best, just as a monopoly was found to work the telegraph best. The National Telephone Company had been held up to ridicule as supplying the worst service in the world; but curiously enough the Government in their proposals to improve that state of things had made up their minds it was wiser not to follow the example of other countries. He trusted that the policy recommended in the Bill would be successful, but he was bound to say that those who knew a great deal about the telephone system were by no means confident that the step taken by the Government in the matter was a wise one. The Bill was then read a second time.

**The Telephone Service.**—The Poplar District Board will not allow the National Telephone Company to lay its main lines underground until it "makes better provision for the public."

**Wireless Telegraphy.**—According to the daily press, experiments in telegraphy without wires are now being made by Messrs. Siemens & Halske at the entrance to Kiel Harbour. The apparatus is placed on the shore and on board the mail steamer *Prinz*

*Sigismund*, which plies between Kiel and Korsör. The net on the land station is 35 metres long, and is suspended from a high mast, while that on the movable station is fixed between the steamer's two masts. So far the results have proved successful and highly interesting. At a distance of 36 kilometres a telegram was successfully sent between the land and the mail steamer as she was d sappearing on the horizon.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Aberdeen.**—August 21st. The Electric Lighting Committee wants tenders for a 12 months' supply of house service and lead covered distributing cables. See "Official notices" this week.

**Barking.**—August 12th. The District Council wants offers for the free wiring of premises within the area of supply. See "Official Notices" July 28th.

**Battersea.**—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

**Battersea.**—August 31st. The Vestry wants tenders for steam pipes, pumps, condensers, economiser, tools, &c., also switchboard and booster. Specifications at the office of Prof. Kennedy, 17, Victoria Street, S.W.

**Birkdale.**—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

**Blackpool.**—August 21st. The Corporation wants tenders for 10 double bogie tramcars. See "Official Notices" July 28th.

**Carlisle.**—August 17th. The Corporation wants tenders for boilers, engines, dynamos, and condensing plant. See "Official Notices" July 28th.

**Darwen.**—August 22nd. The Corporation wants tenders for rail bonds. See "Official Notices" August 4th.

**Devonport.**—August 31st. The District Tramways Company invites tenders for the following contracts: Permanent way, road bed, paving and bonding of about 4½ miles of double line, overhead construction for about 4½ miles of route. See "Official Notices" this week.

**Dundee.**—August 23rd. The Council wants tenders for the overhead line equipment and rail bonding of the Perth Road and Lochee tram routes. See "Official Notices" August 4th.

**East Ham.**—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

**Germany.**—Tenders are at present being invited by the Frankfort-am-Main Municipal Tramways Committee for the supply of 200 steel tyres and 40 sets of wheels and axles for electric tramcars. Tenders to be sent to the Betriebs Direction der Städtischen Strassenbahn, Frankfort-am-Main (Bockenheim), whence particulars may be obtained.

**Glasgow.**—August 21st. The Corporation wants tenders for the supply of switchboards, copper bus bars, and electricity meters. See "Official Notices" August 4th.

**Hackney.**—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" this week.

**Ingleton.**—The Ingleton Electric Light and Power Company wants tenders for the supply of dynamos, switchboards, batteries, and wiring. See "Official Notices" August 4th.

**Malmo.**—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

**Motherwell, N.B.**—August 18th. The Commissioners invite tenders for machinery and works in connection with the proposed electric lighting of their town. See "Official Notices," July 28th.

**Perth.**—August 28th. The Commissioners want tenders for boilers, condensers, steam dynamos, switchboard, underground mains, and accessories. See "Official Notices" July 28th.

**Portugal.**—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

**St. Mary, Battersea.**—August 31st. The Vestry wants tenders for steam pumps, pipes, condenser, economiser, &c., switchboard, and boosters. See "Official Notices" July 28th.

**Southport.**—The Corporation wants tenders for the supply and laying of tram rails, points, crossings, bonding, permanent way; also overhead equipment, including poles, wires, &c. See "Official Notices" this week.

**Sydney (N.S.W.).**—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

**The War Office.**—The Secretary of State for War announces that tenders for various articles, including electrical instruments, will probably be invited from time to time during the next 12 months. Manufacturers who may wish to be applied to when tenders are required, should address Mr. A. Major, Director of Army Contracts, War Office, stating the particular articles they manufacture, and the names of at least two well-known firms or public bodies who have purchased from them, and are in a position to certify as to the quality of their productions.

### CLOSED.

**Barnsley.**—The Council has accepted various tenders for brickwork, iron work, painting, &c., for electric light station buildings; also that of Messrs. Johnson & Phillips for additional plant at £2,236.

**Blackpool.**—The Town Council has accepted the tenders of the Langdon-Davies Motor Company for the supply of a motor-generator.

**Hastings.**—The Council on the 4th inst. accepted Messrs. Glover's tender for extension to mains recently advertised. The following is a list of tenders received:—

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| Glover & Co. (accepted) .. .. .. .. .. .. | £5,848 |
| British Insulated Wire Company .. .. .. .. .. | 6,424 |
| Siemens & Co. .. .. .. .. .. .. | 6,715 |
| Borough Electrical Engineer's estimate .. .. .. .. | 7,225 |
| Callender Cable Company .. .. .. .. .. .. | 7,281 |
| The Western Electric Company .. .. .. .. .. | 10,474 |

**Roumania.**—Messrs. R. Johnson, of Manchester, have succeeded in submitting the lowest tender for the supply of 30 tons of steel wire to the Roumanian Post and Telegraph authorities, quoting 540 francs per ton delivered.

**Whitechapel.**—The Electrical Committee is to have erected apparatus for purifying the feed water for the boilers at the electricity works at a cost of £1,500. The tender of Mr. John Every to supply tanks and apparatus has been accepted.

## NOTES

**The British Association.**—In connection with the forthcoming meeting of the British Association a five days' excursion to Boulogne, Abbeville, Amiens, Arras, Brussels, Antwerp, Ghent, and Ostend, is being arranged. The excursion commences on Thursday, September 21st, and all arrangements are in the hands of Messrs. Thomas Cook and Sons. The French Association for the Advancement of Science meets at Boulogne from September 14th to 21st, and, as already intimated, the French and English Associations will exchange visits. One feature of the French gathering will be the unveiling of a statue of Duchenne, the celebrated French electro-therapeutist, and a new electro-medical section sits for the first time, which the council have formed with a desire to help forward this important branch of applied science. The president of the section is M. J. Bergonié, who has sent us the following note of papers to be contributed:—

1. Traitement par l'Electrolyse des rétrécissements en général et de ceux du canal de l'urèthre en particulier, par le Docteur H. Bordier (de Lyon).
2. Radioscopie et Radiographie Stéréoscopiques par le Professeur Marie (de Toulouse).
3. Récents progrès de la Radiographie, par le Professeur Imbert et le Docteur Bertin-Sans (de Montpellier).
4. De l'Endodiascopie, sa technique et ses résultats, par le Docteur Bouchacourt (de Paris).

**The Northern Light.**—The daily press says that the object of the expedition which recently left Copenhagen for Iceland under the direction of Herr Adam Paulsen, chief of the Danish Meteorological Institute, is to investigate the nature of the northern lights. In this expedition quite a number of instruments of special construction are being used in connection with photography and the measurement of electrical currents.

**Obituary.**—It is with very deep regret that we learn that Mr. Frank King passed away on Thursday last week, at the age of 45 years. For nearly 20 years he had been at work upon accumulators, and in collecting notes as to his career we find that it was in 1881 that he first directed his energies to the subject of secondary batteries generally. He then, in connection with Messrs. Beeman & Taylor, invented the "B. T. K." accumulator, which was used in Colchester in the pioneer days of town electric lighting. He joined the Electrical Power Storage Company in 1886, and his ingenuity soon displayed itself in the improvement of the "E.P.S." type of battery, notably by the design of what was known as the "1888" type. This was followed up in 1889 by the introduction of the "K" type, which was intended to meet the demands of electrical engineers of central stations for high rates of charge and discharge. Both these types of cells are being sold in very large quantities even at the present time. He was also responsible for the design and manufacture of the type of battery which worked the cars on the Barking Road Tramways for some years. In conjunction with the late M. Camille Faure he brought out the well-known form of traction battery which is designated the Faure-King, and which has been employed in working the electrical cabs in London and Paris. In 1889 Mr. King became superintending engineer of the Electric Construction Corporation, but in 1891, when the manufacture of the E.P.S. batteries was resumed by the Electrical Power Storage Company, Mr. King became manager, a position which he filled until the early part of 1898, when, owing to failing health, he was compelled to relinquish his active part in the management, but still took a part in the business as a director and consulting engineer, and, as showing the great interest which he still evinced in storage battery manufacture, even at the time of his death he was at work on an improved plate. It was not only, however, in connection with secondary batteries that Mr. King showed his skill and ingenuity. He was the pioneer of what is known as the direct current high tension transforming system, which he originally started in Colchester in the year 1882 or 1883, and on a greatly improved principle in Chelsea in 1889. In 1892 he also took up the position of managing engineer of the Chelsea Electricity Supply Company, and since that time has been responsible for all its improvements and extensions. In the year 1896 he had the misfortune to break a blood vessel in the lungs, which laid him up for some considerable time, and although he sought by change of climate to recuperate his health, he never completely recovered his strength and former vitality. In the spring of the present year he was compelled to have his arm amputated, and this shock again added considerably to his weakness. About three weeks ago he journeyed to Bexhill-on-Sea for a short spell of change of air, and the day being hot he contracted a slight sunstroke. This in his enfeebled state he was unable to shake off, and he finally passed peacefully away at his home on Thursday, August 3rd. He was buried at the Crystal Palace Cemetery on Tuesday last, in the presence of a large gathering of colleagues and friends which had assembled. Of late years on more than one occasion we have been indebted to Mr. King for valuable information and advice, and our readers will recollect that he gave evidence on behalf of the proprietors of the ELECTRICAL REVIEW in a libel action connected with a secondary battery, brought against this journal some two and a half years ago. Mr. King leaves a widow and several children, one of whom, the eldest son, is on the staff of the E.P.S. Company, and to them we offer our respectful sympathy.

It is also our sad duty to chronicle the passing away of another equally well-known secondary battery inventor, for on Friday last Mr. L. Epstein breathed his last, through sudden failure of the heart's action following some two months' illness. It must be nearly 20 years ago since we first saw Mr. Epstein experimenting with accumulators in the old electric light station of the Pilsen-Joel Company in Whetstone Park, Lincoln's Inn Fields. He went back to Germany for some considerable time and was for several years, we believe, connected with the firm of Siemens & Halske, in Berlin. He then returned to England, where he has resided for the past nine years, and during that period he perfected the well-known Epstein accumulator, first put on the market by Messrs. Woodhouse & Rawson, and later by the company bearing the inventor's name. The history of Mr. Epstein's researches during some 18 years or more may be found scattered throughout the reading columns of the ELECTRICAL REVIEW, and in that portion devoted to "Abstracts of Patents." He was an occasional contributor to our pages, and in our Jubilee issue of November, 1897, the special article on "Twenty-five Years' Progress in Secondary Batteries" was from his pen. On this branch of the electro-technical industry he was an unassuming yet great authority, a conscientious and able experimenter, he never claimed impossibilities for his cells, and his demise, at the comparatively early age of about 46 years, immediately following that of Mr. King, makes a terrible gap, which it will be difficult to fill, in the ranks of the few men who really are thoroughly conversant with their work, and to whom we look for that great desideratum of a light and durable battery of much greater capacity than we have hitherto been able to attain. In like manner to Mr. King he gave evidence for us in the same libel suit. Just previous to his illness he had been engaged in litigation with Mr. Harry Lawson over a patent for an electric motor carriage, and this, to our certain knowledge, had very gravely affected his condition. To his widow and only son we offer our heartfelt sympathy in the sudden and unexpected blow which has befallen them.

The saddest event of all in our unusually long list of obituary notices is the death of Mrs. Patchell, wife of the well-known chief engineer of the Charing Cross and Strand Electricity Supply Corporation. Mr. and Mrs. Patchell were holiday making in Cornwall, and the lady, while bathing, observed a boy struggling out of his depth. She went to the lad's assistance, and kept him afloat until a gentleman swam out to the rescue of both. The boy was safely hauled into a boat, but Mrs. Patchell when taken from the water had fainted, and death resulted from syncope. The sympathies of the whole electrical world will be with Mr. Patchell, whose grief and sorrow will, we hope, be hallowed and softened by the thought that his heroic wife came by her untimely end in the saving of another's life, the noblest and most glorious death that man or woman can desire.

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**Telephonists and Thunderstorms.**—"The danger to telephone users in this country," says a writer in the *Outlook*, "is of the slightest. A storm-discharge usually strikes not a single wire, but a cable or whole 'line' of wires at once, thence, if moderate in amount, is promptly diffused over the whole telephonic system and rendered harmless at any individual point. It may, perhaps, have force enough to produce a dozen vibrations of the striker of the call-bell, but usually only one or two. If one wire alone should be struck or the discharge be unusually violent, the current is so much in excess of the capacity of the wire that it will either overleap the small insulators and pass down a post into the ground or overflow on to the 'ground wires,' which pass from near the cable into the ground in readiness for such an emergency. In America this incident is extremely common, and one may sit in his office and hear the lightning playing a gentle but eerie tattoo upon his telephone bell a dozen times during a thunderstorm. The shocks are occasionally severe enough to make one's head ring, and occasionally to stun for a few moments, but no serious or fatal results have, we believe, ever been recorded. And if this is the case with full-grown American or colonial thunderstorms, what is to be feared from the gentle glow-worm flickerings which are dignified by that title in this little island?" The writer is hardly correct in stating that a storm-discharge usually strikes the wires. The discharge, if it took place towards earth, would, in most cases, take the most direct route to earth, viz, the earth wires of the poles. That the lightning does strike the wires occasionally is, however, indicated by the fact that line wires are sometimes cut in two by fusion during a thunderstorm. The discharge which passes through the line wires is more often an induced effect. It is not correct to say that the discharge becomes toned down by being distributed over the whole set of wires, for it is not a fact that single-wire lines are less free from damage by lightning than those with many wires. A bucket of water thrown over a number of wires would not wet any individual wire less as a consequence of the existence of the other wires.

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**The Institution of Junior Engineers.**—The summer meeting of this Institution is to be held from August 12th to 19th, at Portsmouth and Southampton.

**The Atbara Bridge.**—It appears from a Parliamentary paper issued this week that Lieut.-Colonel Gordon, who managed the purchase of the superstructure of the Atbara bridge, states that the whole question was one of quick delivery, price being practically not considered. Tenders were called for from four English and two American firms. Only one British firm made any offer, viz., the Patent Shaft and Axle Company. The Pencoyd Company, of Philadelphia, offered delivery of a suitable bridge in six weeks, and this offer was accepted, a director of the English firm acknowledging that they could not compete against such quick delivery. He also doubted whether any firm in the United Kingdom could make as good an offer as they had made, their company being, he believed, the only firm in the United Kingdom that rolled their own material. Colonel Gordon further states that the whole of the material for the bridge was inspected by a representative sent from England, from whose report, adds the colonel, "it will be seen how thoroughly the work has been carried out."

**Electric Traction for the Metropolitan Underground.**—The *Standard* ends an editorial regarding the Metropolitan District Railway meeting with the following:—

> Electric traction, which experts believe will, before very long, be made available for the line, would add greatly to the comfort of the passengers, and might completely alter the conditions of the rivalry with omnibuses, which at present are all in favour of the traffic above ground.

Mr. Forbes's statements on Wednesday regarding the use of electric traction on the Inner Circle naturally agreed with Mr. Bell's remarks to the Metropolitan Company a few days previously. Respecting the electrical experiments, he said:—

> These experiments were being steadily continued, but this was a matter which was not so easy as some persons thought. The problem to be dealt with was not that of constructing a railway under the ground which was best adapted to electrical traction, but of converting a railway already constructed and which had other uses. It would be madness to rush into a blind expenditure without some reasonable prevision and experiment. He had, however, been told by these gentlemen that as far as they had gone, their experience induced them to believe that they would be able shortly to establish beyond question the possibility of dealing with the company's enormous traffic by electrical traction, in a manner consistent with the use of other means of traction as far as might be necessary.

**Smoke!**—It is astonishing what an amount of rubbish the sensational journalist can bring forth in regard to the smoke nuisance question. A reasonable movement to avoid excessive smoke nuisance we have a certain amount of sympathy with, but when a halfpenny morning paper says that the smoke fiend is eating away London, the Houses of Parliament are crumbling away, Cleopatra's Needle is losing its point, or, as it is put, "decaying," we tremble at the thought of what may come to pass. We are told that no stringent measures have yet been taken to abolish the nuisance. If the prosecutions and heavy fines imposed upon certain electricity works do not represent stringent measures, then we do not know what does. "We have grown wiser since then," says the writer, referring to events which happened 600 years ago. We thought there must be age behind such utterances. "Smoke is as unnecessary as influenza," and the writer might have added, almost as unavoidable.

**Personal.**—Our correspondent at Wolverhampton says that Mr. T. Parker has relinquished the position of managing director of T. Parker, Limited, but he retains a seat on the board of directors. In addition, the company have appointed him consulting electrical engineer.

We read that Mr. Robert A. Hadfield, chairman and managing director of Hadfield's Steel Foundry Company, Sheffield, is the Master Cutler elect. He is a gentleman with a high reputation for his researches and discoveries in the properties of iron and steel, and his contributions to the Royal Society are familiar to our readers.

**Marriage.**—Mr. Howard Marryat (of Marryat & Place) was married at Richmond, on Saturday last, to Miss Maude Mortham.

**Serious Shock Fatalities at Omaha.**—We take the following from yesterday's *Westminster Gazette*:—"A Central News telegram from New York this morning states that a great fire broke out in Omaha last night, and that four firemen coming in contact with a live electric wire were instantly killed, while two others were fatally injured."

**Appointment.**—Mr. P. T. Macnamara has been appointed Assistant Superintendent of Telegraphs in Ceylon.

## NEW COMPANIES REGISTERED.

**Queen's Dock Electric Works, Limited** (63,113).—This company was registered on July 27th, with a capital of £5,000 in £1 shares (2,000 preference), to acquire, take over as a going concern and carry on the business of electricians, electrical engineers and suppliers of electricity carried on by the Globe Electrical Company at Liverpool and Belfast. The first subscribers (each with one share) are:—P. J. Pakeman, 28, Queen's Avenue, Muswell Hill, N., clerk; H. M. Cordrey, 40, Harders Road, Peckham, S.E., solicitor's clerk; A. W. Read, 11, Ironmonger Lane, E.C., solicitor; J. R. Pakeman, 11, Ironmonger Lane, E.C., solicitor; J. E Simister, 47, New City Road, Plaistow, clerk; R. B. Cannings, 81, Camilla Road, South Bermondsey, clerk; and E Smith, 10, Ironmonger Lane, E.C., secretary. Registered without articles of association. Registered office, 75, Kitchen Street, Queen's Dock, Liverpool.

**Southern Electrical Installation and Wiring Company, Limited** (63,116).—This company was registered on July 27th, with a capital of £10,000 in £1 shares (2,500 preference), to acquire two businesses carried on at Hastings as "Bruce & Co." and "F. Wordley" respectively, to adopt agreements (1) with F. Bruce, (2) with F. Wordley, and (3) with the mayor, aldermen and burgesses of the borough of Hastings, and to carry on the business of electrical apparatus manufacturers, suppliers of electricity for light, heat, and motive power, telephone and telegraph constructors, &c. The first subscribers (each with one share) are:—W. J. Laite, Pelham Hall, Hastings, journalist; A. L. Sayer, Westfield, Sussex, solicitor; H. S. Colt, 33, Havelock Road, Hastings, solicitor; A F. Wood, Gatefield, West Hill, Hastings, clerk; L. F. St. John, 26, Havelock Road, Hastings, auctioneer; H. Kent, 68A, All Saints Street, Hastings, clerk; and Captain A. H. A. Cohill, 16, Pevensey Road, St. Leonards. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £100; remuneration, £75 per annum, divisible. Registered office, 33, Havelock Road, Hastings.

**Browett, Lindley & Co., Limited** (63,128).—This company was registered on July 28th, with a capital of £120,000 in £1 shares, to acquire the business carried on by Browett, Lindley & Co. (incorporated in 1890), at the Sandon Engine Works, Patricroft, near Manchester, and to carry on the business of mechanical, electrical and hydraulic engineers, ironfounders, machinists, tool makers, millwrights, fitters, founders, smiths, builders, hardwaremen, &c. The first subscribers (each with one share) are:—T. Browett, Sandon Works, Patricroft, engineer; H Lindley, Sandon Works, Patricroft, engineer; F. C. Gibbons, Sandon Works, Patricroft, engineer; W. Stead, Sandon Works, Patricroft, engineer; W. R Goulty, Kurnman, Altrincham, engineer; A. Shuttleworth, Duchy Chambers, Clarence Street, Manchester, chartered accountant; and S. B. Beardley, Sandon Works, Patricroft, near Manchester, secretary. The number of directors is not to be less than three nor more than seven; the first are William R. Goulty, Thomas Browett, Herbert Lindley, Frederick C. Gibbons, and William Stead; qualification, £500; remuneration as fixed by the company. Registered office, Sandon Works, Patricroft, near Manchester.

**Renewable Electric Lamp Company, Limited** (63,144).—This company was registered on July 29th, with a capital of £150,000 in £1 shares (50,000 6 per cent. cumulative preference), to carry on the business of manufacturers, renewers, and repairers of and dealers in lamps, wires, and lines of all kinds; electricians, mechanical engineers, suppliers of electricity for the purposes of light, heat, motive power and otherwise, manufacturers of electrical apparatus and fittings, &c. The first subscribers (each with one ordinary share) are:—H. E. Kershaw, 8, Onslow Gardens, Highgate, N., manufacturer; J. Atherton, Singleton, Huyton, Lancashire, manufacturer; C. Howard, 4, Park Lane, St. James's, S.W., electrical engineer; F. G. W. Leslie, 15, Union Court, Castle Street, Liverpool, solicitor; A. W. W. Miller, Savoy Hotel, Strand, gentleman; M. F. Armstrong, 6, Walbrook, E.C., gentleman; J. Spencer, 3, Firsby Road, Stamford Hill, N., gentleman. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £150 each per annum (an extra £50 for the chairman), and a share in the profits.

**Electric Light Railways Limited** (63,060).—This company was registered on July 24th, with 20 members (the subscribers to the memorandum of association being liable for £5 each and other members for £50 each in the event of winding up), to promote, construct, work and maintain railways, light railways, tramways and auxiliary railways, and to carry on the business of

electrical and general engineers, telegraph and telephone constructors, &c. The first subscribers are:—W. I. T. Goatley, 93, Chancery Lane, W.C., accountant; J. Battam, 23, Rood Lane, E.C., solicitor; W. A. Davies, Broadway, Ealing, W., solicitor; W. S. Sargeant, Strand-on-the-Green, Chiswick, W., engineer; T. Hutchinson, Ealing, solicitor; A. F. May, 341, Strand, W.C., advertisement agent; A. Blyth, Lancaster Place, Hampstead, engineer; S. H. Doubleday, 27, Burlington Gardens, Chiswick, chartered accountant; N. Caunter, 12, Heathcote Street, Mecklenburgh Square, W.C., accountant; and G. Cuddon, 140, Camden Road, N.W., gentleman. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, membership (guaranteeing £50); remuneration, £1,000 per annum, divisible.

**Sturtevant Engineering Company, Limited** (63,065).—This company was registered on July 24th, with a capital of £60,000 in £1 shares, to acquire and take over as a going concern the business of engineers, merchants and manufacturers, now carried on at 75, Queen Victoria Street, E.C., by George A. Mower, under the style or firm of the "Sturtevant Engineering Company," to adopt an agreement with the said vendor and to carry on the business of mechanical and electrical engineers, merchants and manufacturers of machinery, tool makers, metal workers, brass founders, boiler makers, smiths, &c. The first subscribers (each with one share) are:—W. J. P. Moore, 153, Queen Victoria Street, E.C., engineer; C. A. Knight, 6, Upper Avenue Road, N.W., engineer; G. A. Mower, 75, Queen Victoria Street, E.C., engineer; P. N. Perrin, 75, Queen Victoria Street, E.C., clerk; C. E. Fox, Christ Church Schoolhouse, Camill Road, Brixton, S.W., clerk; W. J. Bassett, Craigleith, King Charles Road, Surbiton, engineer; and W. C. Burrows, 19, Vassall Road, S.W., engineer. The number of directors is not to be less than three nor more than five; the first are George A. Mower, Charles A. Knight, and William J. P. Moore; qualification, £1,000; remuneration, 5 per cent. of the net profits divided amongst them.

**South Staffordshire Tramways (Lessee) Company, Limited** (63,160).—This company was registered on July 31st, with a capital of £150,000 in £5 shares, to acquire a lease of certain tramways now belonging to the South Staffordshire Tramways Company, and to carry on the business of tramway and light railway proprietors, mechanical and chemical engineers, electricians, suppliers of electricity, manufacturers of electrical apparatus and fittings, carriers of passengers and goods, &c. The first subscribers (each with one share) are:—E. Garcke, Donington House, Norfolk Street, W.C., managing director; J. Raworth, 2, Queen Anne's Gate, S.W., civil engineer; G. Stevens, Donington House, Norfolk Street, W.C., secretary; C. H. Dade, Donington House, Norfolk Street, W.C., assistant secretary; S. Sisson, Donington House, Norfolk Street, W.C., civil engineer; H. M. Sayers, Donington House, Norfolk Street, W.C., electrical engineer; and H. S. Hodgson, Donington House, Norfolk Street, W.C., secretary. The number of directors is to be five, three of whom are to be nominated by the British Electric Traction Company, Limited, and two by the South Staffordshire Tramways Company: no qualification for the first directors; qualification of subsequent directors, £100; remuneration, £500 per annum, divisible. Registered office, Donington House, Norfolk Street, Strand, W.C.

**Electrical Transmission Company, Limited** (63,173).—This company was registered on August 1st, with a capital of £30,000 in £5 shares, to acquire and take over as a going concern the business carried on at Hammersmith as "The Electrical Power Transmission Company," to adopt an agreement with Powell, Jones & Co., and to carry on the business of electricians, mechanical engineers, suppliers of electricity for the purposes of light, heat and motive power, &c. The first subscribers (each with one share) are:—E. Wahab, Golrings, Loughton, Essex, East India merchant; C. Powell-Jones, 7, East India Avenue, E.C., East India merchant; W. E. D. Simpson, 50, Cannon Street, E.C., paper maker; A. R. Clarke, 8, Southwood Avenue, Highgate, assistant; W. E. Starling, 47, Stapleton Hall Road, Stroud Green, N., accountant; T. J. Young, 83, Kent House Road, Beckenham, wharf manager; and D. C. Lee, 46, Queen Victoria Street, E.C., solicitor. Powell, Jones & Co. are to be the first managing agents. Remuneration as fixed by the company.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**F. H. Royce & Co., Limited** (41,362).—This company's annual return was filed on July 10th, when 6,000 preference, 21,480 ordinary, and 500 deferred shares were taken up out of a nominal capital of £60,500 in 6,000 £5 preference shares, 30,000 £1 ordinary shares, and 500 £1 deferred shares. £1 5s. has been called up on 6,000, and £1 on 9,466, the remaining 12,514 £1 shares being considered as fully paid. £16,956 has been received.

**Electric and General Investment Company, Limited** (31,506).—This company's annual return was filed on July 12th, when 20,000 ordinary and 100 founders' shares were taken up out of a capital of £200,000 in 39,900 ordinary and 100 founders' shares, all of £5 each. £1 had been called up on the ordinary, and £5 on the founders' shares, resulting in the receipt of £20,500.

## CITY NOTES.

### The British Westinghouse Electric and Manufacturing Company, Limited.

An extraordinary general meeting of this company was held at the Cannon Street Hotel on Wednesday, 9th inst., for the purpose of complying with the requirement that a general meeting shall be held within four months of the incorporation of the company, and for the purpose of considering and passing resolutions as follows:—

1. Authorising the directors to carry into effect, with or without modification, an agreement dated August 1st, 1899, and made between the Westinghouse Machine Company of the one part and the company of the other part;
2. Increasing the capital of the company to £1,750,000 by the creation of 25,000 ordinary shares of £10 each, such shares to rank in all respects *pari passu* with the existing ordinary shares in the company.
3. Increasing the maximum number of directors from nine to 11, and appointing three additional directors;

And also the following resolution, which, if passed by the required majority, will be submitted hereafter for confirmation as a special resolution:—

4. "That Article 83 of the company's articles of association be altered by the addition thereto at the end of the words 'The directors may also from time to time appoint any qualified person an additional director provided the prescribed maximum number of the board for the time being be not thereby exceeded.'"

The agreement which has been entered into, subject to the approval of the company in general meeting, provides for the acquisition by the company of certain rights, patents, and assistance from the Westinghouse Machine Company of Pittsburg, Pennsylvania, in consideration of the issue to that company or its nominees credited as fully paid up of the 25,000 ordinary shares proposed to be created, the Westinghouse Machine Company covenanting to subscribe or procure subscriptions within a certain period for £250,000 nominal value in preference shares of this company for its general purposes. The company proposes after the expiration of 12 months from the special settlement on the Stock Exchange of the existing preference shares to submit resolutions for the increase of its preference shares by £500,000 nominal value for general purposes in view of the enlargement of the company's sphere of operation. At the conclusion of the general meeting, a meeting of the holders of the existing ordinary shares of the company was to be held for the purpose of giving their separate consent to the resolutions.

Mr. C. W. Benson, who presided, said that so far as the statutory meeting was concerned, there was no particular business to bring before them, as the company's operations had not yet reached that stage when a report could be laid before them. The more important part of the business for consideration was the series of resolutions. Shareholders were perhaps surprised that when the prospectus was issued so recently as July 10th no mention was made of any arrangement with the Westinghouse Machine Company. That was an entirely different company from the Westinghouse Electric and Manufacturing Company, with whom they made their original contract. The business before them was not mentioned in the prospectus, because it was not then in contemplation by the directors; but after the formation of the company third parties made an offer to Mr. Westinghouse to take over the Westinghouse Machine Company's business, in order to manufacture gas engines for Great Britain and its dependencies, and it was then that Mr. Westinghouse gave this company the first offer. The company was formed for making electrical appliances of various descriptions, but electrical appliances all needed some motive power to drive them. It was obvious that it would be convenient to make suitable machines for electric driving from the same works, and that the two classes of machinery could be produced with economy at the same works. Experiments had been in progress for 10 years under Mr. Westinghouse, with the object of producing a really excellent motive power, and the Westinghouse Company was formed to manufacture gas engines. When the formation of the company was determined on, and the details arranged, several months ago, small gas engines up to 250 B.H.P. had been proved to be a success, but the larger sizes, which presented the most profitable commercial field, were still in the experimental stage. In October, 1898, a 650-B.H.P. engine was erected at Pittsburg, and the performance thereof in actual progress had been carefully watched. The engines installed at Chelsea had been examined by some of the highest authorities in this country, and had received very great praise. A 1,500 B.H.P. is now coming through the shops at Pittsburg, and the engineers were confident of its success. Their type of gas engine thus lent itself to sizes much larger than any before possible, and the steadiness of running enabled it to be used for electric lighting, for which purpose gas engines of any considerable sizes had not yet been applied very satisfactorily. Responsible third parties watching the developments of the gas engine, made an offer to Mr. Westinghouse to take over the business. He thought it his duty to come to the board of this company and give them an opportunity of taking over at the same rates. The board consulted Lord Kelvin, and came to the conclusion to acquire the business, patent rights, and assistance of the Westinghouse Machine Company. Lord Kelvin inspected the engines and considered them no longer an experiment but a success, and he referred to the advantages of combining the manufacture of the gas engines in the same works as the electrical apparatus. The board found the area of land they proposed to acquire was sufficiently large to erect a factory to deal with both manufactures. The Westinghouse Machine Company was willing to take the consideration in ordinary shares, which would rank behind the preference shares, but as it was believed that the two manufactures combined would require increased working capital to deal with them effectually, it was believed that after 12 months a

further issue of preference capital could be made. This should not be an occasion for anxiety to the shareholders, because certain responsible persons engaged in the concern had already decided to find £250,000 additional preference capital when required. They would have found it immediately, but as the Stock Exchange rules did not allow of an issue being made within 12 months of the issue of the prospectus, and, furthermore, as the money would not be required for 12 months, the arrangement had been made to put that subscription off for that period. The money was sure, and it could not be other than an advantage to the company to have the additional £250,000 working capital added to its resources. Mr. Westinghouse was on his way to America, but he had written to say that an inspection of the two separate works at Pittsburg showed that there could be carried on within either of the two works the manufacture of both classes of apparatus, and that in general the same class of large and small tools were employed in both kinds of manufacture. He also emphasised the other economies and conveniences that would result from having one works. There would, of course, have to be two classes of engineers—those familiar with electrical construction and those with engineering and general gas and steam engineering. Such engineers working under a single management would become familiar with both classes of construction. The chairman said that as to Article 83, negotiations were on foot between the board and the persons proposing to find the additional money, for the appointment of additional directors, but the time had not yet arrived for their appointment, nor were all the names definitely settled, but they would be all gentlemen whose services would be of great value to the company. He then formally moved the adoption of the resolutions given above.

Mr. Joseph Lawrence, in seconding the resolution, told what had happened to the English company. The company was constituted with a million and a half nominal capital. Half a million in ordinary shares was allotted to the Westinghouse Company at Pittsburg for patents, assistance, plans, &c.; half a million of the preference capital was allotted to the public, and applications came in for £632,280, the list of subscriptions to that amount embracing some of the most prominent names in the world of finance and banking in London and England. The board were arranging for the purchase of land for building the works at Manchester. They chose a site at Manchester instead of London, &c., because it afforded facilities for obtaining cheaper land, a large and abundant supply of the best skilled labour, and the situation was in the centre of the manufacturing industries. An architect had been engaged, and Mr. Westinghouse had gone to America with him to confer with him at his own works in Pittsburg, with a view to getting the best points from those works. Mr. Westinghouse was of opinion that the building of the works would proceed in a manner unprecedented in England, and put up in a record time. It was possible that the Carnegie Company, of Pittsburg, might supply the ironwork for the works within four months. If they let out contracts in England just now for such works the makers could not deliver within two or three years. That made it possible to proceed with double-quick time. This was not a company on paper, it was a living company buying a living business, increasing by leaps and bounds. The French company formed by Mr. Westinghouse had only been in existence a short time, but had obtained contracts amounting to several millions of francs in connection with the Paris Exhibition and other great works. One day's work recently amounted to 3½ millions of francs. Business promised to be equally prosperous in this country. Regarding the amalgamation question, the chairman said that the proposed amalgamation with the engine company was not contemplated at the time the prospectus was issued. That was strictly true in terms, but the subject was not absent from the minds of Lord Kelvin and Mr. Parsons, their colleague, nor was it absent from his own mind. Whilst the negotiations were in progress it was decided that it was better to carry out the arrangements for the electrical business first and discuss amalgamation with the other afterwards. The advantage of the amalgamation was so apparent as not to need his advocacy. The only question was deciding what was the phychological moment. If they had not settled when they did they might have had to pay higher terms for effecting the amalgamation. Mr. Westinghouse had practically produced an engine of all grades up to 1,500 H.P. In this country, up to quite recently, they thought it a splendid thing if they could do 200 H.P. His engines had been the subject of years of experiment. Not only was his system likely to supplant the present type of gas engine in use in this country, but it would make a trade for itself. It did away with the pulley band, because the shaft was directly connected with the engine. That was one of many valuable features in the Westinghouse engine. They were convinced that there was a field for gas engines over and above the electrical business. This was not the first time Mr. Westinghouse had made his bow to the British public. They all knew of the gigantic success of the Westinghouse brake. His electrical business had begun in a small way, and had developed to such an extent, that it was now represented by a live capital of $13,500,000. Orders were flowing in upon him, so that it became well nigh impossible for him to conduct his European business, and it became necessary that he should seek the assistance of European capitalists in forming a branch of his business here. England was in a deplorably backward state as regards electrical development. It was perfectly painful for anybody who had watched the progress in Germany and America, to see the backward position we are in in England. It was a solid fact, and might be news to some of them that an important railway contract that was let in the first instance to an English firm, could not be carried out by that firm because of the largeness of the contract and the time involved. It was taken up by a German firm, and the length of road was to be constructed in London by German capital and German labour. That was a reproach to British enterprise. This company could congratulate itself upon a happy combination of English and American capital. The list of shareholders included the leading capitalists, from Lord Rothschild downwards. They had a solid business and solid backers. He was going to Pittsburg himself in a fortnight, and the insight and experience he would get at the works would be at the company's service. He was perfectly convinced that this was a sound business, which would be highly remunerative if carefully managed. He seconded the resolutions.

Mr. Ormrod (a shareholder) expressed very strong feeling of dissent at the proposals contained in the circular. His firm acted as the Manchester brokers of the company, and they and a considerable number of friends were shareholders. The prospectus was dated July 10th, and the agreement the board had made with the Westinghouse Machine Company was dated August 1st. It seemed to him a very peculiar thing, in fact a most startling and unique thing, that a circular of that kind should be sent out within so short a period of the issue of the prospectus. There was not a word mentioned in the prospectus as to the existence of a Westinghouse Machine Company, and either the amalgamation should have been known about at that time or it must have been very hastily considered since. He and his friends did not know of the existence of such a company. They had received no information at all as to its profit-making capabilities. The Westinghouse Electric Company—the British Company—they understood to be doing a live business. There were actual results to show, but the Machine Company, so far as they knew, might never have passed the experimental stage. He had had letters from many shareholders in the Manchester district, and they were unanimous in expressing a very strong feeling of dissent at the proposals. No doubt the board were well able to carry their proposals, and he had not come with proxies or anything of that kind. The chairman had made possibly a more or less satisfactory explanation of the circumstances, but to justify such a course as was proposed needed a very satisfactory explanation indeed. He would suggest that a very full and explicit explanation be sent to the shareholders, many of whom were unable to be at the meeting, before formally passing the resolutions. He and his friends applied for shares because it was an electric company. They knew nothing whatever about the machine company. They believed in the possibilities of an electrical company. There might be equally good, if not greater, possibilities in front of the machine company, but they knew nothing about that. He had heard big names mentioned as the parties who were prepared to find that additional £250,000, and he was very much surprised at their countenancing such a proceeding.

The Chairman, in reply, said that what Mr. Ormrod had said was exactly his own feeling, and if he had not felt it his duty absolutely in the interests of the shareholders from the evidence that the directors had, which must be submitted in this way, owing to the circumstances of the case, he would never have voted for it.

Mr. Lawrence said that, having an eye to the value of the preference shares, this was a good bargain, attested by the fact that there was an organisation ready to take the business. He took it that Mr. Ormrod looked at the matter from the position of an ordinary shareholder and underwriter. The preference shares would absolutely benefit by the proposed amalgamation. If Mr. Westinghouse and others chose to give them something of a valuable nature, patents, plans, &c., in return for ordinary shares which had to wait for one, two or three years for a return, that was no concern of his. He was looking only at the preference shareholders who subscribed the cash capital. Several of the leading shareholders were informally consulted, and approved of the scheme. There was absolutely no dissent on the board as to the wisdom of the policy. If it was postponed for 12 months the gentlemen who were finding the additional capital would not hand it over for the same amount of money as to-day. It was absolutely essential to the business that the amalgamation should take place. It would be a retrograde step to postpone the adoption of the resolution.

After a few further remarks had passed between Mr. Ormrod and Mr. Lawrence, the resolutions were carried unanimously, and the usual vote of thanks closed the meeting.

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## Anglo-American Telegraph Company, Limited.

Mr. F. A. Bevan presided at the half-yearly meeting of this company at Winchester House last Friday. He said the directors were pleased to give such a very satisfactory statement with regard to the receipts for the half-year. Compared with the corresponding half-year of 1898 a falling off might naturally have been expected, as at that time the Spanish-American war was raging, and an immense amount of traffic was sent over their lines, but it was a matter for congratulation that not only had the receipts equalled in amount those of the first half of 1898, but had actually exceeded it by £256. Looking back and taking the figures for the corresponding half-years from 1894 they found that the increase had been gradual and steady from £134,000 to £202,000 in five years. The expenses this year are only larger over those of 1894 by £5,300. The proportion of expenses in 1894 was 41·41, and in 1899 30·19. In addition to ordinary revenue the *Minia* had earned £5,987 more. Since the last meeting they had lost the captain of the *Minia*. To Captain Trott they were greatly indebted for the vast amount of good work that he did, and they hoped that his successor would equal him in his skill. That source of revenue might fairly be called accidental in more senses than one, and therefore could not possibly be relied upon. The accounts are now presented in such a form, that shareholders could at once compare the figures of one half-year with the other. To refer to these briefly, taking into account on one side the increase of the *Minia's* expenses, owing to the amount of employment she had had, and on the other the reduced expenditure on cable, arising from the fact

that they had had to spend less upon their repairs in the shape of cable, they found that the total increase of receipts had been £6,154. There was a net reduction of expenses of £590, and an increased balance brought forward of £377, so that the total increase of revenue earned and carried forward was £7,121, being £24,701 as against £17,580. That was a most satisfactory statement. During the past year the increase in the renewal fund had been £53,129, so that not only had they had a very satisfactory half-year so far as working was concerned, but they had added to the strength of the company. In the balance-sheet sundry debtors, including the traffic balances, stood at £120,000—£60,000 more than last year. Their debtors were solvent people. They were Governments, and the companies who were in alliance with them. Some of that money had been already paid, and the rest was sure to come. The money owing being so large, the cash in hand was correspondingly small, but that was to some extent righting itself, and shortly would have done so completely. They had begun the new half-year very well, the increase in the gross receipts for the month of July being £2,700, and the *Minia* had already earned during July as much as she did during the whole of the six months in 1898, and there was no doubt that she would earn more. Therefore, barring some extraordinary accident, they would have a very good half-year. As regards the German Cable Company, they had no doubt seen paragraphs in the papers as to what the German Government, or new German Cable Company was going to do, but he could give them no definite information upon the point. The subject had occupied the attention of the directors during the past few months, and it would not be owing to any want of zeal or energy on their part that things turned out not exactly as they hoped and wished. As to what had been called the interminable French law suit, he was glad to tell them it was not altogether interminable. He could say something definite about it, though they had not yet got any cash. In May last, the Court of Appeal, of Rouen, gave judgment in favour of this company for £258,000, less such amount as a committee of experts might determine to repay the value of the assistance rendered by the French Company to the Anglo-American Company by having placed its new cable at the service of the Anglo-Company during the period of performance of the joint-purse agreement, so far as such assistance might not have already been paid for. So far as the board knew, all such assistance *had* been already paid for—every message was paid for as it was sent. Therefore apparently they might look forward to a very nice little addition to their renewal fund, but getting the money was different from a judgment in your favour. As to when they would get the money, or how much they would get, the shareholders knew as much as he did. He thought the decision would justify the directors in the shareholders' eyes in not having dropped the matter, although it might have appeared that they were fighting for a shadow. He would be very pleased when he could announce that they had got the money. He moved the adoption of the report, which appeared in our last issue.

Mr. C. Burt seconded the motion, which was carried unanimously, and the usual vote of thanks closed the meeting.

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**The City of London Electric Lighting Company, Limited.**—Warrants have been posted for the payment of an interim dividend for the half-year ended June 30th, 1899, at the rate of 6 per cent. per annum on this company's 6 per cent. cumulative preference shares (£400,000 in 40,000 shares of £10) Nos. 1 to 40,000.

**Yesterday's City Meetings.**—On Thursday a meeting of the National Telephone Company was held at Cannon Street Hotel, and of the Waterloo and City Railway at Waterloo. Reports of the proceedings will appear in our next issue.

## TRAFFIC RECEIPTS.

**The Blackpool and Fleetwood Tramroad Company.**—The receipts for the week ending August 5th, 1899, were £1,859 13s. 8d.; receipts for week ending August 5th, 1898, £1,125 18s. 4d.; aggregate, July, 1899, to date, £5,813 5s. 7d.

**The Bristol Tramways and Carriage Company, Limited.**—The receipts for the week ending August 4th, 1899, were £3,660 5s. 2d.; corresponding period 1898, £3,981 18s. 5d.; decrease, £321 13s. 3d. (Bank Holiday week).

**The City and South London Railway Company.**—The receipts for the week ending August 6th, 1899, were £933; week ending August 7th, 1898, £1,105; decrease, £172. Total receipts for half-year, 1899, £5,632; total receipts corresponding period, 1898, £5,861; decrease, £229. Miles open, 3½.

**The Dover Corporation Electric Tramways.**—The receipts for the week ending August 5th, 1899, were £272 9s. 11d.; week ending August 6th, 1898, £272 12s. 7d.; decrease, 2s. 8d. Total receipts to date, 1899, £5,485 5s. 7d.; corresponding period, 1898, £4,446 18s. 9d.; increase, £1,038 6s. 10d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,553; 1898, 3,906. Number of cars, 1899, 11; 1898, 10.

**The Dublin United Tramways Company.**—The receipts for the week ending Friday, August 4th, 1899, were as follows:—D. U. T. Co., horse cars, £2,246 18s. 11d.; ditto, electric cars, £1,265 18s. 4d.; D. S. D. Co., electric cars, £1,155 8s. 8d.; total, £4,668 5s. 11d.; corresponding week last year—D. U. T. Co., horse cars, £2,800 8s. 7d.; ditto, electric cars, £737 12s. 6d.; D. S. D. Co., electric cars, £1,342 6s. 0d.; total, £4,880 7s 1d.; decrease, £212 1s. 2d. Aggregate to date, £22,758 19s. 2d.; aggregate to date last year, £22,745 17s.; increase to date, £13 2s. 2d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

**The Liverpool Overhead Railway Company.**—The receipts for the week ending August 7th, 1899, amounted to £1,654; corresponding week last year £2,007; decrease, £353. 1898 includes Bank Holiday.

**The South Staffordshire Tramways Company.**—The receipts for week ending August 4th, 1899, were £746 13s. 2d.; aggregate receipts for 31 weeks, £19,967 8s. 5d.; week ending August 5th, 1898, £881 13s. 11d.; aggregate receipts for 31 weeks, £19,373 6s. 11d.

## STOCKS AND SHARES.

Wednesday Evening.

The hot weather and the holidays have combined to restrict business in electrical undertakings to the smallest compass, but as the rest of the Stock Exchange is suffering from precisely the same complaint, those who are interested in electrics have no more reason for grumbling than the rest of the house. Indeed, there is a cause of thankfulness to notice how steadily quotations are maintained, because a stagnant market is usually inclined to the down grade. There is hardly a bargain doing in electrical railway descriptions, but the best of prices exhibits no alteration. By the way, the Stock Exchange official list quotes City and South London new Ordinary, with £3 10s. per share paid up, at 2⅞—3⅛, while the £10 fully-paid ordinary are only 6¼—6⅜. The former is, of course, a mistake. Bordeaux tramway shareholders, who have not yet done so, should immediately avail themselves of their option to purchase shares in the Compagnie Francaise des Tramways Electriques et Omnibus, as there is a premium of £2 per share on them.

Concerning the other varieties of traction shares there is not very much to say. The quiet reading of Light Railway Bills in Parliament goes on month by month, and its fruit will probably be ripening soon, if what we hear about sundry new issues to be made shortly is correct. Anglo-Argentine Trams are hard at 4¼, and Buenos Ayres and Belgrano "A" Preference are well maintained at 4½, the pending call upon the latter having had no effect upon the price. The 4½ per cent. Debentures of the Tramways Union are nominally 101 to 105, but holders are naturally keeping the market very short of stock, as there seems no doubt but that the debentures will be paid off at 110 at once, instead of at par in 1918.

Among the electricity supply companies the noticeable feature of the week has been the fluctuations in City of Londons. After the hurried scamper to get out on the part of those who were so disappointed at the passing of the dividend, it was only to be expected that a reaction would occur. Besides, as we urged when writing last, the company's directors adopted the only safe course, and it was the calm consideration of this view that materially assisted in putting up the price of Citys to the extent of a point, only, however, to relapse again as more sellers came in on the rise. Charing Cross fail to recover the ground they lost last week, and the market is very curious to know how the money will be raised for bringing the company into the City. The share capital of the Charing Cross, *i.e.*, a quarter of a million sterling, is all issued, and its £70,000 worth of 5 per cent. debentures are redeemable at par next year. The company, however, possesses borrowing powers to the tune of £150,000.

Glancing over the remainder of the list, it is observable that prices manage to retain their quotations of last Wednesday, but are unable to make up for the fall which lowered the market all round 10 days back. This is due partly to the fact that some fears are entertained for the companies' prosperity if copper keeps at its present price. It has gone up so rapidly within the last six months, and shows such apparent strength, that it was argued electric supply companies would feel the difference keenly when they came to extend their cables, as they constantly have to do. The same line of reasoning applies, of course, in a much more limited way, to telegraph and telephone companies, but so far this factor has not seriously entered into Stock Exchange consideration. Metropolitan Electric, both old and new, have added to their quotations during the week.

Eastern Telegraph Ordinary stock has been more cheerful, principally because nothing has lately appeared in the papers about the new Pacific cable. The 5 per cent. Debentures rose a point upon their approaching redemption this month. These bonds were issued 20 years ago, in order to acquire £200,000 worth of shares in the Eastern and South African Company, Limited. A large part of the issue has already been converted into the 4 per cent. Debenture stock of the Eastern Company. Of the American companies, the Anglo-American is still the market favourite; but Directs also rose a fraction.

Manufacturing shares are steady. Wireless Telegraph have moved up 10s., but no recordable change is shown by the Telegraph Manufacturing issues. Henley's 7 per cent. Preference have been inquired for, and reflect the demand in their price. Callender's Cable Ordinary are unchanged; the Preference are quoted 5½—6. Telegraph Construction have regained part of the dividend, and this department seems to be worth the investor's attention. National Telephones are being bought, and the anticipated trouble in Glasgow has quite blown over.

## SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1896. | 1897. | 1898. | Closing Quotation, August 2nd. | Closing Quotation, August 9th. | Business done during week ended August 9th, 1899. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 124,400£ | African Direct Telegraph, 4 % Debs. ... ... ... | 100 | ... | ... | ... | 100 —104 | 100 —104 | ... | ... |
| 25,000 | Amazon Telegraph, shares ... ... ... ... ... | 10 | ... | ... | ... | 3 — 4 | 3 — 4 | ... | ... |
| 125,000 | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | ... | ... | ... | 85 — 90 | 85 — 90 | ... | ... |
| 905,560£ | Anglo-American Telegraph ... ... ... ... ... | Stock | £2 13s | 3 % | £3 9s | 61 — 64 xd | 62 — 65 xd | 62½ | ... |
| 3,047,220£ | Do. do. 6 % Pref. ... ... ... | Stock | £5 6s | 6 % | 6 % | 113 —114 xd | 114 —115 xd | 114⅜ | 113¾ |
| 3,047,220£ | Do. do. Deferred... ... ... ... | Stock | ... | ... | 18s. % | 13¾— 14¼ | 13¾— 14¼ | 14⅛ | 13⅛ |
| 205,151 | Brazilian Submarine Telegraph ... ... ... ... | 10 | 7 % | 7 % | ... | 15 — 15½ | 15 — 15½ | 15 | ... |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 ... | 100 | ... | ... | ... | 108 —112 | 107 —111 | 108½ | ... |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 ... ... ... ... | 5 | 4 % | 4 % | ... | 2½— 3 | 2½— 3 | ... | ... |
| 10,000,000$ | Commercial Cable ... ... ... ... ... ... | $100 | 8 % | 8 % | 8 % | 188 —193 | 188 —193 | ... | ... |
| 1,332,523£ | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | ... | ... | ... | 104 —106 | 104 —106 | 105¼ | 105 |
| 224,850 | Consolidated Telephone Construction and Manufacturing | 10/- | 2 % | 1½% | 1 % | ⅛— ¼xd | ⅛— ¼xd | ... | ... |
| 16,000 | Cuba Telegraph ... ... ... ... ... ... ... | 10 | 8 % | 7 % | 8 % | 9 — 10 | 9 — 10 | 9⅛ | ... |
| 6,000 | Do. 10 % Pref. ... ... ... ... ... | 10 | 10 % | 10 % | 10 % | 18½— 19½ | 18½— 19½ | 19¼ | ... |
| 12,931 | Direct Spanish Telegraph ... ... ... ... | 5 | 4 % | 4 % | ... | 4 — 5 | 4 — 5 | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. ... ... | 5 | 10 % | 10 % | ... | 9½— 10½ | 9½— 10½ | ... | ... |
| 30,000 | Do. do. 4½ % Debs. ... ... ... | 50 | ... | ... | ... | 103 —107% | 103 —107% | ... | ... |
| 60,710£ | Direct United States Cable ... ... ... ... | 20 | 3 % | 3½% | 3½% | 11½— 12 | 11⅜— 12¼ | 11⅞ | 11¼ |
| 120,000 | Direct West India Cable, 4½ % Reg. Deb. ... ... ... | 100 | ... | ... | ... | 100 —103 | 100 —103 | 100½ | ... |
| 4,000,000 | Eastern Telegraph, Ord. Stock ... ... ... ... | Stock | 6½% | 7 % | 7 % | 150 —155 xd | 151 —156 xd | 154 | 152 |
| 1,795,000 | Do. 3½% Pref. Stock ... ... ... | 100 | ... | ... | ... | 98 —102 xd | 98 —102 xd | 100 | 99¼ |
| 89,900 | Do. 5 % Debs., repayable August, 1899 ... | 100 | 5 % | 5 % | ... | 101 —104 xd | 101 —104 | ... | ... |
| 1,432,268£ | Do. 4 % Mort. Deb. Stock Red. ... ... | Stock | 4 % | 4 % | ... | 115 —120 | 115 —120 | 117¾ | 115½ |
| 250,000 | Eastern Extension, Australasia, and China Telegraph ... | 10 | 7 % | 7 % | 7 % | 14½— 15 | 14½— 15 | 14⅝ | 14½ |
| 16,200£ | Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326 | 100 | 5 % | 5 % | ... | 99 —103 | 99 —103 | ... | ... |
| 64,400£ | Do. do. Bearer, 1,050—3,975, 4,327—6,400 | 100 | 5 % | 5 % | ... | 100 —103 | 100 —103 | ... | ... |
| 320,000£ | Do. 4 % Deb. Stock ... ... ... ... ... | Stock | 4 % | 4 % | ... | 114 —119 xd | 114 —119 xd | ... | ... |
| 35,100£ | Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343 | 100 | 5 % | ... | ... | 99 —103 | 99 —103 | ... | ... |
| 46,500£ | Do. do. do. to bearer, 2,344 to 5,500 | 100 | 5 % | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 300,000£ | Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909 | 100 | 4 % | ... | ... | 101 —104 xd | 101 —104 xd | 102¼ | ... |
| 200,000£ | Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000 | 25 | 4 % | ... | ... | 102 —105% | 102 —105% | ... | ... |
| 180,227 | Globe Telegraph and Trust ... ... ... ... | 10 | 4½% | 4½% | 5⅛% | 10⅜— 11¼ | 10⅜— 11¼ | 11 1/16 | 10⅞ |
| 180,042 | Do. do. 6 % Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 15 — 15½ | 15¼— 15⅝ | 15 7/16 | 15¼ |
| 150,000 | Great Northern Telegraph, of Copenhagen... ... ... | 10 | 10 % | 10 % | ... | 29 — 31 | 30 — 32 | ... | ... |
| 83,500 | Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 17,000 | Indo-European Telegraph ... ... ... ... ... | 25 | 10 % | 10 % | 10 % | 48 — 52 | 48 — 52 | ... | ... |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. ... ... | 100 | 6 % | 6 % | ... | 109 —112 | 109 —112 | ... | ... |
| 71,000 | Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ... | 1 | ... | ... | ... | ¼— ½ | ¼— ½ | ... | ... |
| 84,000 | Do. do. 5% Pref., Nos. 1 to 84,000 | 1 | ... | ... | ... | ½— 1 | ½— 1 | ... | ... |
| 490,000 | National Telephone, 1 to 490,000 ... ... ... ... | 5 | 5½% | 6 % | 6 % | 5⅝— 5⅝ | 5⅝— 5⅝ | 5 9/16 | 5½ |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 13 — 14 | 13 — 14 | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 13 — 14 | 13 — 14 | 13½ | ... |
| 250,000 | Do. 5 % Non-cum. 3rd Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5⅜— 5⅝ | 5⅜— 5⅝ | ... | ... |
| 1,329,471£ | Do. 3½ % Deb. Stock Red. ... ... | Stock | 3½% | 3½% | 3½% | 99 —102 | 99 —102 | 100 | ... |
| 171,504 | Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid | 1 | 5 % | 5 % | 5 % | ⅞— 1 | ⅞— 1 | ... | ... |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ... | 100 | 4 % | 4 % | ... | 103 —106 | 103 —106 | ... | ... |
| 11,839 | Reuter's ... ... ... ... ... ... ... | 8 | 5 % | 5 % | ... | 7 — 8 | 7 — 8 | ... | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 130 —135 | 130 —135 | ... | ... |
| 58,000 | United River Plate Telephone ... ... ... ... | 5 | 5 % | 6 % | ... | 4⅜— 5¼ | 4⅜— 5¼ | ... | ... |
| 151,733£ | Do. do. 5 % Debs. ... ... ... | Stock | ... | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 200,000£ | West African Telegraph, 5 % Debs. ... ... ... ... | 100 | 5 % | 5 % | ... | 100 —103 | 100 —103 | ... | ... |
| 30,008 | West Coast of America, Nos. 1—30,000 and 53,001—53,008 | 2½ | ... | ... | ... | ½— 1 | ½— 1 | ... | ... |
| 150,000 | Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel. | 100 | ... | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 339,521 | Western and Brazilian Telegraph 4 % Deb. Stock Red. ... | Stock | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 88,321 | West India and Panama Telegraph ... ... ... ... | 10 | 1 % | 2% | ... | 1⅜— 1⅝ | 1⅜— 1⅝ | ... | ... |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. ... | 10 | 6 % | 6 % | ... | 10¼— 10⅝ | 10¼— 10⅝ | ... | ... |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. ... | 10 | 6 % | 6 % | ... | 8¾— 9¼ | 8¾— 9¼ | ... | ... |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | 5 % | 5 % | ... | 103 —106 | 103 —106 | ... | ... |
| 158,100£ | Western Union of U.S. Telegraph, 6 % Ster. Bonds ... | 100 | 6 % | 6 % | ... | 100 —105 | 100 —105 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 80,000 | Charing Cross and Strand Electricity Supply ... ... | 5 | 6 % | 7 % | 8 % | 9½— 10½ | 9½— 10½ | ... | ... |
| 20,000 | Do. do. do. do. 4½ % Cum. Pref. | 5 | ... | ... | ... | 5⅝— 6¼ | 5⅝— 6¼ | ... | ... |
| 84,000 | *Chelsea Electricity Supply, Ord., ... ... ... ... | 5 | 5 % | 6 % | 6 % | 7½— 8½ | 7½— 8½ | ... | ... |
| 100,000 | Do. do. do. % Deb. Stock Red.... | Stock | 4½ % | 4½ % | ... | 112 —114 | 113 —115 | ... | ... |
| 60,000 | City of London Electric Lighting, Ord. 40,001—100,000 ... | 10 | 7 % | 10 % | 6 % | 11 — 12 | 11½— 12½ | 12½ | 11¾ |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 ... ... ... | 10 | 6 % | 6 % | 6 % | 12½— 13½ | 12½— 13½ | 13¼ | 12¾ |
| 400,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | 5 % | ... | 123 —128 | 123 —128 | 125½ | ... |
| 40,000 | County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000 | 10 | nil | nil | nil | 11 — 11½ | 11 — 11½ | ... | ... |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | 6 % | 13 — 14 xd | 13 — 14 xd | ... | ... |
| 220,000 | Do. 4½% Deb. Stock, Prov. Certs (£60% to be paid) Rd. | ... | ... | ... | ... | 51 — 53 | 51 — 53 | ... | ... |
| 17,400 | Edmundsons Elec. Corp., Ord. Shares 1—17,400 ... ... | 5 | ... | 5 % | 7 % | 5¼— 5⅜ | 5¼— 5⅜ | ... | ... |
| 19,661 | House-to-House Electric Light Supply, Ord., 101 to 19,661 | 5 | ... | 4 % | 6 % | 7½— 8½ | 7½— 8½ | 8 | 7¾ |
| 12,000 | Do. do. 7 % Cum. Pref. ... | 5 | 7 % | 7 % | ... | 8½— 9½ | 8½— 9½ | ... | ... |
| 110,000 | London Electric Supply Corporation, Limited, Ord. ... | 3 | ... | ... | ... | 3½— 4 | 3½— 4 | ... | ... |
| 48,050 | Do. do. do. 6 % Pref. | 5 | ... | ... | 6 % | 6½— 7 xd | 6½— 7 xd | 6⅞ | 6 13/16 |
| 100,000 | Do. do. do. 4% 1st Mt. Db. Stock Rd. | Stock | ... | ... | ... | 105 —107 | 106 —107 | ... | ... |
| 62,500 | Metropolitan Electric Supply, 101 to 62,500 ... ... | 10 | 5 % | 6 % | 5 % | 14½— 15½ | 15 — 16 | 15⅛ | 15 |
| 22,500 | Do. Nos. 62,501 to 85,000 ... ... ... | 10 | ... | ... | ... | 14 — 15 | 14½— 15½ | ... | ... |
| 220,000£ | Do. 4½ % First Mortgage Debenture Stock | ... | 4½% | 4½% | ... | 117 —119 | 117 —119 | ... | ... |
| 6,452 | Notting Hill Electric Lighting ... ... ... ... | 10 | 4 % | 6 % | 6 % | 15 — 16 | 15 — 16 | 15 | ... |
| 81,980 | St. James's and Pall Mall Electric Light, Ord. ... ... | 5 | 10½% | 14½% | 14½% | 16 — 17 xd | 16 — 17 xd | 16¾ | ... |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 9 — 10 xd | 9 — 10 | ... | ... |
| 65,000 | South London Electricity Supply, Ord., £4 paid ... ... | 5 | ... | ... | ... | 4 — 4¼ | 4 — 4¼ | ... | ... |
| 79,900 | Westminster Electric Supply, Ord., 101 to 80,000 ... | 5 | 9 % | 12 % | 12 % | 14¼—15½ xd | 14½— 15½xd | 15⅜ | 14¾ |

* Subject to Founder's Shares.
† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
§ Dividends paid in deferred share warrants, profits being used as capital;
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1896. | 1897. | 1898. | Closing Quotation Aug. 2nd. | Closing Quotation Aug. 9th. | Business done during week ended Aug. 9th, 1899. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 60,000 | Aluminium "A" shares, Nos. 1—60,000 ... ... ... | 1 | 10 % | 10 % | ... | 3¼— 3⅜ | 3¼— 3⅜ | ... | ... |
| 90,000 | Do. 4½ % 1st Mort. Deb. Stock Red. ... ... | Stock | ... | ... | ... | 95 —100 | 95 —100 | ... | ... |
| 30,000 | British Electric Traction ... ... ... ... ... | 10 | ... | ... | 6 % | 17½— 18½ | 17½— 18½ | ... | ... |
| 10,000 | Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.) | 10 | ... | ... | ... | 14 — 14½ | 14 — 14½ | 14½ | ... |
| 20,000 | Do. do. do. Nos. 40,001—60,000 | 10 | ... | ... | ... | 13⅜— 14¼ | 13⅜— 14¼ | 14 | 13¾ |
| 200,000 | Do. do. 5 % Perpetual Debenture Stock ... | Stock | ... | ... | ... | 127 —130 | 127 —130 | 128½ | ... |
| 90,000 | Brush Elecl. Enging., Ord., 1 to 90,000 ... ... ... | 3 | *nil* | *nil* | ... | 1⅜— 2 | 1⅜— 2 | 1 1/16 | ... |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | *nil* | 4 % | ... | 2⅛— 2⅜ | 2⅛— 2⅜ | ... | ... |
| 125,000*l* | Do. do. 4½ % Perp. Deb. Stock ... | Stock | ... | ... | ... | 110 —114 | 110 —114 | ... | ... |
| 50,000 | Do. do. 4½ % 2nd Deb. Stock Red. ... | Stock | ... | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 20,000 | Callender's Cable Construction shares, Nos. 1—20,000 ... | 5 | 10 % | 12½% | 15 % | 14½— 15½ | 14½— 15½ | 15¼ | 14 13/16 |
| 90,000 | Do. do Ord. shares, Nos. 1 to 22,500 ... | Stock | ... | ... | ... | 112 —115 | 112 —115 | ... | ... |
| 35,250 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 10¼— 10⅜ | 10¼— 10⅜ | 10⅜ | 10 7/16 |
| 178,303 | Do. do. do. £8 paid ... ... | 10 | ... | ... | ... | 8¼— 8⅜ | 8¼— 8⅜ | ... | ... |
| 61,033 | Do. do. Pref. half-shares £3 paid ... | ... | ... | ... | ... | 2⅜— 3¼ | 2⅜— 3¼ | ... | ... |
| 71,447 | Do. do. Def. do. £5 paid ... | ... | ... | ... | ... | 5¼— 5⅜ | 5¼— 5⅜ | ... | ... |
| 630,000*l* | City and South London Railway ... ... ... ... | Stock | 1 9/16 % | 1⅞% | 2⅛% | 67 — 69 | 67 — 69 | ... | ... |
| 22,500 | Do. do. Ord. shares, Nos. 1 to 22,500 ... | 10 | ... | ... | ... | 6¼— 6⅜ | 6¼— 6⅜ | ... | ... |
| 32,098 | Crompton & Co., Nos. 1 to 32,098 ... ... ... ... | 3 | ... | ... | ... | 3½— 4 | 3½— 4 | ... | ... |
| 100,000 | Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red. | ... | ... | ... | ... | 99 —102 | 99 —102 | ... | ... |
| 99,261 | Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261 | 5 | 5⅛% | 6 % | 6 % | 2 — 2½ | 2 — 2½ | ... | ... |
| 17,139 | Do. do. do. "A" Shares, 01—017,139 | 5 | 5⅛% | 6 % | 6 % | 4 — 5 | 4 — 5 | ... | ... |
| 344,023 | Do. do. do. 4 % Deb. Stock Red. ... | 100 | ... | ... | ... | 95 — 97 | 95 — 97 | ... | ... |
| 112,100 | Electric Construction, 1 to 112,100 ... ... ... ... | 2 | 5 % | 6 % | 6 % | 2⅛— 2⅜xd | 2⅛— 2⅜xd | ... | ... |
| 25,000 | Do. do. 7 % Cum. Pref., 1 to 25,000 ... | 2 | 7 % | 7 % | 7 % | 3 — 3½xd | 3 — 3½xd | ... | ... |
| 140,300 | Do. do. 4% Perp. 1st Mort. Deb. Stock ... | Stock | ... | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 91,196 | Elmore's Patent Copper Depositing, 1 to 70,000 ... ... | 2 | ... | ... | ... | ⅝— ⅞ | ⅝— ⅞ | ... | ... |
| 9,600*l* | Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ... | 10 | 7 % | 7 % | 7 % | 11 — 13 | 11 — 13 | ... | ... |
| 15,000 | Henley's (W. T.) Telegraph Works, Ord. ... ... ... | 10 | 10 % | 12 % | 14 % | 25 — 26 | 25 — 26 | 25½ | ... |
| 3,000 | Do. do. do. 7 % Pref. ... ... | 10 | 7 % | 7 % | 7 % | 19 — 21 | 20 — 22 | ... | ... |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock... | Stock | 4½ % | 4½ % | ... | 111 —114 | 111 —114 | 111 | ... |
| 50,000 | India-Rubber, Gutta-Percha and Telegraph Works ... | 10 | 10 % | 10 % | 10 % | 21 — 22 | 21 — 22 | 21 1/16 | 21⅜ |
| 300,000 | Do. do. do. 4 % 1st Mort. Debs. | 100 | ... | ... | ... | 102 —106 | 102 —106 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 2⅞% | 3¼% | 3¼% | 8 — 8½ | 8 — 8½ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 % | 5 % | 14 — 14½ | 14 — 14½ | ... | ... |
| 37,350 | Telegraph Construction and Maintenance ... ... ... | 12 | 15 % | 15 % | 15 % | 37 — 41 xd | 38 — 42 | 38½ | 38 |
| 150,000 | Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ... | 100 | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 13,400 | Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ... | 5 | ... | ... | ... | 9¼— 9¾ | 9¼— 9¾ | ... | ... |
| 13,400 | Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000 | 5 | ... | ... | ... | 5⅝— 6¼ | 5⅝— 6¼ | ... | ... |
| 540,000*l* | Waterloo and City Railway, Ord. Stock ... ... ... | 100 | ... | ... | 3 % | 102 —105 | 101 —104 | ... | ... |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

## LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8½—9½.
British Aluminium, Ordinary, no market; 7 % Pref., no market.
House-to-House, 4½% Debentures of £100, 104—107.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3 nom.
*T. Parker, £10 (fully paid), 19—20.

* From Birmingham Share List.

**Bank rate of discount 3 per cent. (February 2nd, 1899).**

## MARKET QUOTATIONS, Wednesday, August 9th.

| CHEMICALS, &c. | This week. | Last week. | Increase or Decrease. |
|---|---|---|---|
| *a* Acid, Hydrochloric .. .. per cwt. | 5/- | 5/- | .. |
| *a* „ Nitric .. .. .. per cwt. | 22/- | 22/- | .. |
| *a* „ Oxalic .. .. .. per cwt. | 32/- | 32/- | .. |
| *a* „ Sulphuric .. .. .. per cwt. | 5/6 | 5/6 | .. |
| *a* Ammoniac, Sal .. .. .. per cwt. | 37/- | 37/- | .. |
| *a* Ammonia, Muriate (crystal) .. per ton | £26 | £26 | .. |
| *a* „ „ .. .. per ton | £24 | £24 | .. |
| *a* Bleaching powder .. .. per ton | £5 15 | £5 15 | .. |
| *a* Bisulphide of Carbon .. .. per ton | £15 | £15 | .. |
| *a* Borax .. .. .. per ton | £16 10 | £16 10 | .. |
| *a* Benzole (90 %) .. .. .. per gal. | 7/- | 7/- | .. |
| *a* „ (50/90 %) .. .. per gal. | 5/6 | 5/6 | .. |
| *a* Copper Sulphate .. .. .. per ton | £25 | £26 5 | 25s. dec. |
| *a* Lead, Nitrate .. .. .. per ton | £23 10 | £23 10 | .. |
| *a* „ White Sugar .. .. per ton | £31 | £31 | .. |
| *a* „ Peroxide .. .. .. per ton | £27 10 | £27 10 | .. |
| *a* Methylated Spirit .. .. per gal. | 2/9 | 2/9 | .. |
| *a* Naphtha, Solvent (90 % at 160° C.) .. .. .. .. per gal. | 5/6 | 5/6 | .. |
| *a* Potash, Bichromate, in casks.. per lb. | 3½d. | 3½d. | .. |
| *a* „ Caustic (75/80 %) .. per ton | £24 | £24 | .. |
| *a* „ Bisulphate .. .. per ton | £35 | £35 | .. |
| *a* Shellac .. .. .. .. per cwt. | 68/- | 68/- | .. |
| *a* Sulphate of Magnesia .. .. per ton | £4 10 | £4 10 | .. |
| *a* Sulphur, Sublimed Flowers .. per ton | £6 | £6 | .. |
| *a* „ Recovered .. .. per ton | £5 10 | £5 10 | .. |
| *a* „ Lump .. .. .. per ton | £5 | £5 | .. |
| *a* Soda, Caustic (white 70 %) .. per ton | £7 10 | £7 10 | .. |
| *a* „ Crystals .. .. .. per ton | £3 | £3 | .. |
| *a* „ Bichromate, casks .. per lb. | 2¾d. | 2¾d. | .. |
| **METALS, &c.** | | | |
| *b* Aluminium Wire, in ton lots .. per ton | £224 | £224 | .. |
| *b* „ Sheet, in ton lots.. per ton | £191 | £191 | .. |
| *p* Babbitt's metal ingots .. .. per ton | £90 to £160 | £90 to £160 | .. |
| *c* Brass (rolled metal 2" to 12") basis per lb. | 8¼d. | 8¼d. | .. |
| *c* „ Tube (brazed) .. .. per lb. | 10½d. | 10½d. | .. |
| *c* „ Wire, basis .. .. per lb. | .. | 8½d. | .. |

| METALS, &c. *(continued)*. | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|
| *f* Ebonite Rod .. .. .. per lb. | 8/- | 8/- | .. |
| *f* „ Sheet .. .. .. per lb. | 5/- | 5/- | .. |
| *g* Copper Bars .. .. .. per ton | £88 | £88 | .. |
| *g* „ Wire (basis price) .. per lb. | 10½d. | 10½d. | .. |
| *g* „ Sheet .. .. .. per ton | £88 | £8 | .. |
| *g* „ Rod .. .. .. per ton | £88 | £88 | .. |
| *n* German Silver Wire .. .. per lb. | 1/6 | 1/6 | .. |
| *h* Gutta-percha, fine .. .. per lb. | 6/- | 6/- | .. |
| *h* India-rubber, Para fine .. per lb. | 4/3 | 4/1 to 4/3 | .. |
| *i* Iron, Charcoal Sheets .. .. per ton | £18 | £18 | .. |
| *i* „ Pig (Cleveland warrants) per ton | 68/6 | 71/6 | 3s. dec. |
| *i* „ Forgings, according to size per ton | From £11 | From £11 | .. |
| *i* „ Scrap, heavy .. .. per ton | 50/- to 55/- | 50/- to 55/- | .. |
| *i* „ Wire galvanised No. 8 .. per ton | £12 | £11 5 | 15s. inc |
| *g* Lead, English Ingot .. .. per ton | £14 10 | £14 10 | .. |
| *g* „ „ Sheet .. .. per ton | £15 7 6 | £15 7 6 | .. |
| *m* Manganin Wire No. 28.. .. per lb. | 8/- | 8/- | .. |
| *g* Mercury .. .. .. per bottle | £8 7 | £8 7 | .. |
| *d* Mica (in original cases), small per lb. | .. | 1½d. to 6d. | .. |
| *d* „ „ „ medium per lb. | .. | 1/9 to 2/6 | .. |
| *d* „ „ „ large per lb. | .. | 3/6 to 7/- | .. |
| *p* Phosphor Bronze, plain castings per lb. | 1/1 to 1/4 | 1/1 to 1/4 | .. |
| *p* rolled bars & rods per lb. | 1/1 to 1/4 | 1/1 to 1/4 | .. |
| *p* „ r'l'd strip & sheet per lb. | From 1/2½ | From 1/3½ | .. |
| *o* Platinum .. .. .. .. per oz. | £3 10 | £3 10 | .. |
| *p* Silicium Bronze Wire .. .. per lb. | 10½d. to 1/1 | 10½d. to 1/1 | .. |
| *i* Steel, Magnet, acc'd'g to desc'p'n p. ton | From £15 | to £40 | .. |
| *i* Steel, Magnet, in bars .. .. | £58 | £58 | .. |
| *g* Tin, block .. .. .. .. per ton | £146 10 | £146 10 | .. |
| *g* „ foil .. .. .. .. per lb. | 1/6 | 1/6 | .. |
| *n* „ wire Nos. 1 to 16 .. .. per lb. | 1/10 | 1/10 | .. |
| *p* White Anti-friction Metals— "White Ant" brand .. per ton | £40 to £70 | £40 to £70 | .. |
| *j* Yarns, Cotton, Single 10lb. bundles pr lb. | 7½d. | 7½d. | .. |
| *j* „ Best Flax, 6 lea. .. per lb. | 4½d. | 4½d. | .. |
| *j* „ Hemp, 3 ply 10 lbs. .. per lb. | 3½d. | 3½d. | .. |
| *j* „ „ Russian, 10 lbs. per lb. | 4½d. | 4½d. | .. |
| *j* „ Jute, 180 lbs. rove .. per ton | £12 10 | £12 | 10s. inc |
| *j* „ Manila, 24 thread .. per ton | £32 10 | £32 10 | .. |
| *k* Zinc, Sheet (Vielle Montagne bnd.) p.t. | £28 10 | £28 10 | .. |

Quotations supplied by
*a* Messrs. G. Boor & Co.
*b* The British Aluminium Company, Ltd.
*c* Messrs. Thos. Bolton & Sons.
*d* Messrs. F. Wiggins & Sons

Quotations supplied by
*f* The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
*g* Messrs. James & Shakespeare.
*h* Messrs. Jackson & Till.
*i* Messrs. Bolling & Lowe.
*j* Messrs. Henry C. Yeo & Co.

Quotations supplied by
*k* Messrs. Morris Ashby, Limited.
*m* Messrs. W. T. Glover & Co., Ltd.
*n* Messrs. P. Ormiston & Sons.
*o* Messrs. Johnson, Matthey & Co., Ltd.
*p* The Phosphor Bronze Company, Ltd.

# THE MUNICIPAL ELECTRICAL ASSOCIATION.

## THE ARRANGEMENT OF STEAM AND OTHER PIPES, AND THEIR FITTINGS.

By J. E. Edgcome, M.I.M.E., M.I.E.E.

*Borough Electrical Engineer, Kingston-upon-Thames.*

The subject of steam and other piping is one of the greatest importance to engineers of central stations, and, indeed, to all who have to deal with steam plant. It is a subject upon which volumes might be written and still leave much unsaid.

The author does not pretend to advance any especially new or original information, but rather a series of notes based on some little experience, in the hope of eliciting what should prove to be a most interesting discussion, and a discussion from which every member may be able to carry away some useful suggestion, to be put into practice when laying down a new generating station, or when carrying out the inevitable extension of his present works.

The arrangement of piping referred to in this paper is proposed for small or for moderate sized stations, which form the majority, rather than for those very large stations to be found in a few of the big cities, and where, possibly, special arrangements are necessary.

### Steam Pipes.

The author is of opinion that in the majority of cases, the best and most favourable arrangement of steam piping is in the form of a steam ring, running from the boiler house through the engine house and returning to the boiler house, as shown in fig. 1.

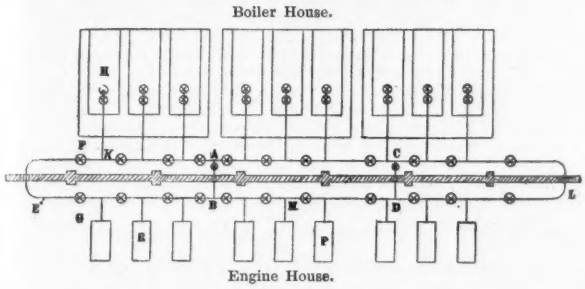



Fig. 1.

It is advisable that the ring should be cross connected at two or more places, as shown at A B and C D, so that in the event of repairs being necessary to any pipe—say at E—the closing of the valves, F G, does not necessitate, in case boiler H is under steam, that the steam should pass to the engines—say P or R—by the long route, H A L M, but by the shorter route, H A B M.

This arrangement will also allow of considerable lengths of steam pipe being cut out when the engines and boilers upon them are not in use, and will be found to give greater flexibility to the ring system.

In most cases, particularly when the engine house and boiler house are approximately on the same level, it is usually more convenient to carry the steam piping overhead, and where a single line of boilers is installed backing towards the dividing wall, and similarly a single line of engines is laid down with the engines abutting towards the same wall, it is extremely simple to carry out the steam ring system.

Where a double row of engines is installed the system becomes a little more complicated, and it is usually advisable to form a second loop of steam piping in parallel with the main ring within the engine house, feeding the engines on either side, the engines in that case facing one another with the machines outward.

Serviceable and reliable steam pipes may be made up of lap-welded mild steel with heavy wrought-iron flanges, the flanges being screwed on hot and the ends brazed. The flanges must, of course, be faced up to enable good joints to be made.

In larger sized steam pipes it will be found that the joints can be kept tighter by having the flanges made with a slight boss, which is faced up for the joint, instead of the whole of the flange being faced up for that purpose, as shown at A in fig. 2; from $\frac{1}{16}$ inch to $\frac{1}{8}$ inch is sufficient for the thickness of the boss.

Steam pipes, where supported on brackets or columns, should be carried on rollers to allow of free contraction and expansion.

### Joints.

With the higher steam pressures now in use, care and discrimination are required in making and keeping good sound joints. There are innumerable makes of jointing material on the market. Rubber prepared with plumbago makes a good sound joint, which requires taking up when steam is admitted to the pipe, as the material softens with the heat, although it sets into a hard permanent joint when tightened up.

An admirable and reliable joint is one made with corrugated brass rings, painted with thin red lead.

### Drainage.

One of the most prolific causes of trouble with steam piping is that from accumulation of water, and too much care cannot be taken in thorough draining of the pipes.

For this purpose a number of separators should be fitted in the ring on the boiler side to collect the water from the steam where it leaves the boilers, and, in the author's opinion, it is certainly advisable that every engine should be fitted with its own separator, to deal with any water which may be carried over from the main steam pipe.

To deal, however, with the water which will, notwithstanding, collect in the main steam ring in the engine house, it is advisable to connect the ring in several places to steam traps, similar traps being connected to the separators of the engines.

The author has found from experience that, to permanently connect the engine separators to steam traps, deals more effectually with the water trouble than to constantly blow out the water from the

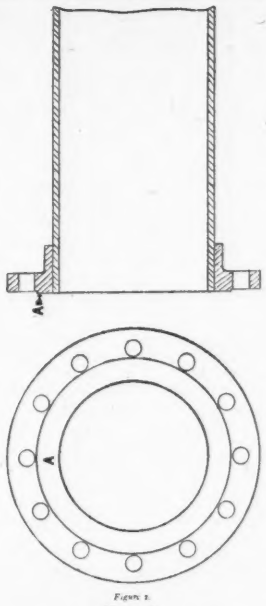



Fig. 2.

separators as it collects there, especially in view of the difficulty experienced in ascertaining the quantity of water in the separators, except by the use of gauge glasses, which are a source of constant trouble owing to the difficulty of getting glasses to withstand the pressure when there is any variation of temperature, or when they are subjected to sudden cold draughts.

The connecting pipes from the boilers to the main steam pipe, and from the main steam pipe to the engines, should be preferably of copper, with full swan neck bends to keep the water back as much as possible, and to allow of expansion.

### Steam Traps.

These are most necessary adjuncts to the steam pipes; but although there are some very good steam traps on the market, probably most engineers will agree than an ideal trap has yet to be discovered.

All steam traps require a certain amount of attention, and should be fitted with a reliable class of stop valve to enable them to be shut off from the live steam main for inspection, and for the renewal of the valves and seatings when necessary.

Most of the modern traps will discharge at a considerable height, depending, of course, upon the steam pressure, and it will be found that a quantity of excellent feed water may be collected by this means.

When discharging to a height, each trap should be fitted with a non-return valve to prevent the column of condensed water in the pipe returning to the trap. It will be found convenient to group the discharge pipes from a number of steam traps into a small tank, having an overflow pipe to the hot well. This will enable the discharge of every trap to be inspected, which is a necessary precaution to ensure that each is in proper working order.

### Valves.

Valves are a very important part of a steam system, and care should be taken to select a class of valve suitable for the work which it has to perform.

Full way valves possess so many advantages over other types, that in the most modern plants these are almost wholly used for high pressure steam work, and can be obtained from the smallest to the largest size.

The large valves on the main steam ring should each be provided with a small by-pass valve to enable a length of cold steam pipe to be warmed up, and the pressure balanced before the main valve is opened. This will prevent the straining of the joints caused by sudden expansion, and likewise accidents due to water hammer.

When erecting new steam pipes, attention should be given to the thorough cleaning of the pipes, as otherwise fine particles of grit, driven by the steam into the faces of the valves, cut into the seats, causing considerable trouble and expense. The author was informed by one large firm of valve makers that, owing to the trouble they had experienced from this cause, and the expense to which they had been put, due to the necessity of taking down and refacing valves fitted in this manner on new pipes, they intended in future to include in their estimates a certain sum to cover such cost.

Where, as is almost universally the case, boilers are run in parallel, it is advisable to fit a self-acting valve between the steam ring and the main stop valve on each boiler, the self-acting valve being placed immediately after the stop valve. There are various types of this valve, the usual form being a ball working on an inclined plane. The object in all cases is to provide a valve which shall close automatically when the pressure on the boiler it controls falls below that in the steam ring, as this enables that particular boiler, when thus isolated, to recover itself and to get up a full head of steam, upon which the automatic valve reopens, and again connects the boiler to the steam main.

### Blow-Off Valves.

Where the boiler blow-off valves discharge into one common pipe, as is usually the case, it is very necessary that the blow-off valve should be of some type in which the handle shall be practically locked when open. This will prevent the blow-off from a live boiler being forced into a boiler which is standing off for the purpose of being cleaned. Want of attention to this precaution has been the cause of many accidents, frequently involving the death of the men working in the boilers.

This locking arrangement is usually carried out by the use of some special form of key, in which the key is held locked in the valve as long as the valve is open, and can only be withdrawn when the valve is shut; and as long as one key only is available, it is, of course, impossible for two valves to be open simultaneously.

As, however, a key is supplied with every valve, the spare keys, which it is advisable to keep in case of breakage, should be locked up, in charge of one of the engineers, and should not be available in the works.

The author remembers seeing on a battery of boilers, which had been carefully fitted with this class of valve, two of the blow-off valves open at one time with, of course, a key to each valve, entirely doing away with the element of safety, and further causing this false feeling of security to become an added danger.

Where the blow-off from the flooding valves of super-heaters are led into the same blow-off pipe, and when, as is usual, a type of two-way valve is used which cannot be fitted with a locked key, possibilities of accident are averted by making a stringent rule that the flooding valves must not be opened unless the key of the boiler blow-off valves is hanging within sight.

### Check Valves.

The check valves of boiler feed pipes are more convenient, for the purpose of inspection, when fitted with an arrangement which allows the valve and seating to be inspected while the boiler is under steam, and the author would also suggest the convenience of fitting every feed branch with a plug-cock, having a removable handle, to enable each check valve to be shut off for inspection both from its own boiler and from the feed main.

A plug cock with removable handle is recommended in place of an ordinary wheel valve, as the latter may be accidentally closed, whereas the handle would be fitted to the former only for the specific purpose of examining the check valve or for completely cutting off the water supply from a boiler when standing off.

The feed supply would, of course, in all cases be regulated by means of the check valves themselves.

Perhaps the author may be permitted to say a few words on the subject of feed water supply.

A convenient arrangement is to connect the pump suctions through suitable pipes and valves to the hot well, the cold well, and also to a third supply in case of emergency, and to connect the discharge pipes from the pumps to a double line of piping supplying the feed water either through the filters and one or more economisers, or if required direct to the boilers.

In the accompanying diagram fig. 3, A A A are the feed pumps, B the

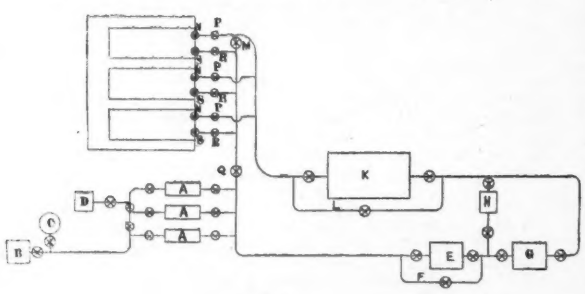



Fig. 3.

hot well, C the cold well, D the tank connected to a third supply, E is a cloth filter with by-pass F; G a sawdust filter fitted in series with E, with a by-pass sawdust filter H, the by-passes being used when the main filters are being cleaned. This arrangement has given excellent results, leaving the boilers clear of all traces of oil, which formerly proved a source of considerable trouble and anxiety.

The condition of the sawdust in G and H is a good indication of the condition of filter E, and proves whether or not it is doing its work properly.

K is the economiser with by-pass L, to enable it to be inspected and cleaned without passing the feed direct to the boilers *viâ* Q, which would entail cutting the filters out of circuit.

The arrangement of the branches from the hot and cold feed, enables the boilers to be fed either with hot or cold water through the stop cocks and check valves P N or R S, and by opening valve M, cold water can be fed through the hot feed check valves, or the reverse, should any of the branch pipes or check valves be out of order.

### Pipe Covering.

A few words must be said with reference to the various coverings in use for preventing radiation of heat from steam pipes.

It is most necessary that all pipes carrying steam should be enclosed in a covering of some non-conducting material.

Endless varieties of pipe coverings exist which may be divided into two classes, permanent coverings and removable coverings.

The former, which are generally wrapped with some description of linen or canvas, have a good finished appearance when coloured and varnished, but suffer from the disadvantage that the covering is destroyed when it is necessary to remove it from the pipe at any point, and the appearance of the whole length of pipe is spoilt in consequence.

Removable coverings are, on the other hand, as their name implies, specially made for the purpose of allowing free inspection of the pipe, but in appearance they are usually clumsy, and do not lend themselves to the neat finish of permanent coverings. It is also questionable whether, as a rule, they are such efficient non-conductors of heat as are permanent coverings.

It would take up too much time to attempt to describe the many varieties of coverings on the market. They are all manufactured from some good non-conducting material, such as asbestos, magnesia, slag-wool, or felt, and are put on either wet or dry.

There are also numbers of coverings which depend principally for their non-conducting properties upon an air space being left around the pipe.

Probably every engineer has been induced at some time to try various coverings, and, like the author, has possibly found a few good, many indifferent, and some distinctly bad.

There is no doubt that to obtain an efficient steam supply with a minimum of condensation every portion of steam carrying metal must be covered with a thoroughly good non-conductor, and where practicable all valves and flanges should be treated in the same manner.

This applies equally to the drain pipes, or, at any rate, to that portion connecting to the steam traps. For the sake of keeping down the temperature in the engine house it is generally advisable also to cover the exhaust pipes with some non-conducting material.

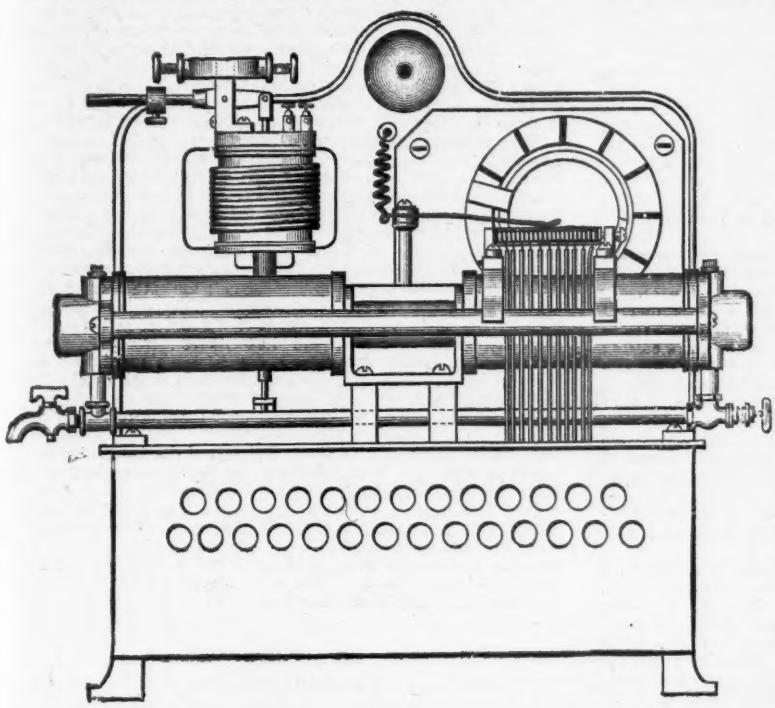
Much more might be said on the subject of pipe work, but the author trusts that what he has advanced will fulfil his expectations, namely, to produce a useful and exhaustive discussion on what he ventures to think is a most important portion of central station equipment.

## ELECTRIC LIGHTING MACHINERY.

A wail goes up in the *Engineer* from time to time. These wails are recurrent in our revered contemporary, and appear to be coincident with periods of depression to which we are all at times subject. At such moments our contemporary becomes pessimistic but never forgets to write in thoroughly autocratic style. This time electrical machinery and electrical stations come under review. The ignorance of electrical facts is deplored. Engineers have tried to live up to the science of the dynamo by employing scientific many-jointed engines and boilers. They have been like the suburban family living up to the high æsthetic level of the blue teapot. We should prefer to have used the other simile which says something about living up to the blessed doctrine of total depravity, for to our mind this is rather what has been aimed at. Electrical engineers have themselves to thank for most of their troubles. They began wrongly by criticising the wasteful methods of the factory engineers, but this was because so many of them were not men of practice. They emerged from class-rooms and designed stations and plant with no margins. To make matters worse, they undertook the use of untried forms of engines and novel boilers, and taking them all in all they have made a very good job of getting 1,000 H.P. out of a 600 or 700 H.P. plant. There has been too much expected from plant, more from new devices than it was known could be got from old and proved machinery. Everything not absolutely new and fresh in design has been condemned as fossilised. The professor has had full sway. He has worked up from theory to practice, and has taught his pupils to do the same, and in crossing the borderland between theory and practice there is very much rough country, which has never been allowed for. We admit the theory has been false theory in that it has refused to take notice of experimentally determined facts. The theoretical men have been like the lawyer who, at a conference with a client in gaol, said emphatically, "they can't put you in gaol for this." "But," responded the client, "I am in gaol." So with the new school of engineers, they have theorised too much and worked with insufficient margins. They have harped so much on the high cost of land in London and they have crowded plant to such a narrow limit that the dismantled and breakdown stuff occupied more space than would have held other plant. Then, again, in the subversion of the entire design of steam plant, old established firms have been shut out of the market. Being busy on other work, these old firms have preferred to wait until there appeared to be some finality in design. So far, except that there seems to be a tendency to revert to older methods, there is no finality in view. We think that the most successful undertakings of the near future will be those in which the fever heat observable in so many electrical stations is replaced by a more leisurely appearance. We want engineers who have the courage to demand plant of more capacity, and managements which are prepared to give it.

## STEADY LIGHT FROM UNSTEADY POWER.

The economical and efficient operation of a plant of incandescent electric lamps involves the nice adjustment of two opposing factors which enter as items of expense. As one item is increased in any given case, the other is decreased, and *vice versâ*. These two factors are, on the one hand, the life of the lamps, and on the other hand,



the power consumed in operating the lamps. The life of a lamp is favoured by making it a great watt consumer. A lamp using 4 watts per C P. has a much longer life, other things being equal, than a 2½-watt lamp, but the power used makes it expensive to use. On the other hand, the 2½-watt lamp, when subjected to fluctuations of voltage, becomes expensive in the item of lamp renewals. Close regulation is important for any lamp, but when the low-watt lamp is used it becomes an all-important factor in economy, and it is not infrequent to see in a lighting station one or more attendants constantly engaged in watching the voltmeter and operating a hand regulator as the changes of load or speed demand. The high-watt lamp is necessarily expensive in the item of power, and the low-watt lamp is also expensive in the item of lamp renewals when the regulation is poor; but the low-watt lamp, combined with perfect regulation, is the perfection of economy with incandescent electric lighting. Every electrical engineer fully appreciates this fact, and a good voltage regulator is the urgent demand of the times; this demand is claimed to be fully met in the Chapman voltage regulator, which Messrs. Laing, Wharton & Down, Limited, are now putting on the market. A large number of these are in practical operation, and have proved to be all that could be desired. A dynamo that has 750 4-watt lamps capacity can supply 1,000 3-watt lamps with the same amount of energy. The close regulation which can be obtained by use of the Chapman voltage regulator not only increases the capacity of the machines, but reduces lamp renewals, due to the constantly steady voltage.

The regulator is a magnetic device, and acts very promptly, being only limited in quickness of action by the ability of the generator it may be regulating to respond to change on a field resistance. The device is essentially a field resistance, whose operation is entirely automatic. The moving of the resistance switch is accomplished by the action of a working solenoid, and the actions of the working solenoid are determined by those of an auxiliary solenoid, which operates a set of contacts that control the admission of current to the sections of the working solenoid. The working solenoid is differentially wound, and is composed of four distinct coils, two of which have a small continuous current flowing through them in magnetic opposition to each other; the contacts close the circuit of one or the other of remaining coils, and so neutralise the action of one of the continuously acting coils.

This manner of connecting secures a rise of magnetism in the iron core of the solenoid whenever a break occurs at the contacts, and so avoids any injurious sparking at the contacts that would naturally occur by the magnetic discharge of the core. This arrangement completely neutralises the induction discharge, and no induction spark can occur. All the usual objections to contact points are therefore entirely removed, and they may be set very close to secure the most sensitive adjustment of the apparatus.

The entire work of the auxiliary solenoid is to move a lever arm with contact attached through a short space of, say, $\frac{1}{32}$ inch, and a very slight change of voltage is sufficient to do this. It is often desirable to have the voltage at the generating station rise a little with the load, so that it becomes greater than the voltage at the distributing point or end of feeder, where it remains constant with changes of load. This result is aimed at in the compound winding of generators, but in most cases is far from securing the result desired on account of the changes of speed, which no compounding of the generator can compensate for. The compounding of the auxiliary solenoid, however, secures the desired result under all conditions of speed or load, and a plain shunt wound generator becomes just as effective as a compound wound generator. The use of the Chapman regulator enables the old style alternating current generators having no compound coils to do just as good work as the more modern ones. Many machines that have been discarded as out of date will again become valuable and equal to the best.

The same is also true of direct current generators. There are many old generators of the shunt wound type, that will become just as useful as the more modern built machines, and even more so, by the attachment of the voltage regulator to them.

As to the energy consumed in the regulator, it is so small as to be negligible. The operation of the large working solenoid only requires the use of 60 to 70 watts of energy, and the resistance part of the device is concerned only with the current in the shunt winding of the generator which, as is well known, is only a very small percentage of the output of the machine. For instance, the regulator may be operated on a machine of 150 KW. with an expenditure of energy not exceeding ¼ H P.

The Chapman voltage regulator for varying speed dynamos solves a question of enormous importance to users of electric light. Central station engineers know the importance of unvarying voltage. It is simply out of the question to think of satisfying the general public without an almost absolutely steady light, and there is no way of doing this except by means of some kind of a regulator outside of the generator itself.

The Chapman voltage regulators are applicable to either alternating or direct current, and every plant subject to frequent changes of load and consequent change in voltage, run either by engine or water power, should have them. Their cost is slight compared with advantages gained by their use.

Several direct current machines connected in multiple may be controlled with one regulator, as well as though a regulator were used for each machine, but require special construction and must be so ordered.

Mills and factories can run light plants from their main line shafting without the necessity of special engines, even if there is a variation of 50 per cent. in the speed above the normal, and be assured of a steady light, a fact that could not possibly be accomplished by any other means without enormous loss by burning out lamps many times exceeding the cost of one of these regulators in a very short time.

They are claimed to do automatically what would otherwise require the constant attention of one man.

The size of the No. 1 style is 36 × 17 × 8 inches, and the weight is about 250 lbs. No. 2 is less highly finished, and is not enclosed with a plate glass front.

## THE PROPERTIES AND APPLICATIONS OF ALUMINIUM.

MM. Ditte and Moissan have recently contributed to the French Academie des Sciences important papers on the above subject. Owing to the gradual extension of the field of utilization of this metal, we think these papers worthy the attention of our readers, and we therefore present abstracts of them below:—

### THE PROPERTIES OF ALUMINIUM.

A. Ditte. *Comptes Rendus.* January 23rd, 1899.

In a previous article the author had proved that aluminium is readily attacked by many re-agents, and that its apparent stability is due to a thin adhesive film of alumina ($Al_2 O_3$), or of gas. When the solvent used is one capable of dissolving alumina, corrosion occurs rapidly, since the protective coating is being continually removed. The presence of oxygen or of carbonic acid is required in order to provide the necessary supply of oxygen. In sea water, the same re-action occurs, the carbonic acid of the air being in this case the oxidising agent. In the water of the Seine itself, aluminium is slowly corroded, the action being most marked at the point where the air and water meet. In either case, the attacked metal covers itself with a film of alumina, which may retain particles of other salts. If these impurities are allowed to remain in contact with the aluminium, the attack will slowly continue, and the metal will become disintegrated, even after removal from the water. To prevent this, it is necessary to wash the aluminium when taken from the water, with a

solution capable of removing the last traces of alkaline matter from its surface. The "sickness" of copper investigated by M. Berthelot, is a similar phenomenon to this progressive disintegration of aluminium. In the case of copper, the successive formation and decomposition of a small amount of cuprous oxide is the cause of the evil; in the case of aluminium a similar series of changes of aluminium hydrate brings about disintegration and decay.

## THE PROPERTIES AND APPLICATIONS OF ALUMINIUM.

A. Ditte. *Comptes Rendus.* March 27th, 1899.

The author states that two qualities of aluminium were employed in his experiments. The first was sheet metal used for the bodies of bowls, plates, saucers, saucepans, measures, &c., and contained 96 per cent. aluminium, 3 per cent. copper, and 1 per cent. of iron, silicon, carbon. The second grade of metal was used for the rings, links, handles, &c., of the above articles, and contained 93 to 94 per cent. aluminium, 5 to 6 per cent. copper, and 1 per cent. of iron, silicon, and carbon.

These alloys, if maintained for a short time at a red heat, and then plunged into water, change in physical structure. They become granular, and the surface of the metal is found to be covered with fine cracks.

If immersed in a 2 per cent. solution of sulphuric acid, the action of the acid is more intense when pre-heating has occurred, and the surface of the metal covers itself with a black deposit of copper.

A 2 per cent. solution of an alkali carbonate, or a solution of common salt containing 8 grams NaCl per litre, rapidly attacks these alloys of aluminium at the ordinary temperature, and a coating of aluminium hydrate, $Al(OH)_3$, is produced upon the metal. If a polished plate of the metal be immersed in either of these solutions, it quickly loses its polish, and becomes coated with a thin film of crystalline alumina.

The effects of similar action are seen in the aluminium vessels, &c., returned from Madagascar. A piece of aluminium plate, a fragment of a portable water-tank, had its external surface practically uninjured, while its interior surface was found to have undergone physical change and to have become lamellar and fragile. Under the microscope it was seen to be strongly corroded and to be covered with aluminium hydrate.

This inner surface of the plate was more rapidly attacked by sulphuric acid and sodium carbonate solutions than the outer surface, and a metallic crystalline powder was detached. If a thin aluminium sheet be immersed in distilled water, the latter will gradually become alkaline owing to the transfer of small quantities of aluminium hydrate, sodium and chlorine, from the metal to the water; and the combined action of air and of water, containing possibly chlorine salts in solution, had no doubt *started* the disintegration of the inner surface of the metal used for these water tanks. Once begun the action would be self-supporting.

All the other Madagascar articles examined by the author (plates, measures, saucepans), showed signs of similar disintegration. The action of water and air on the cooking vessels was probably intensified by the materials cooked in them. The E.M.F. set up by the different solubilities of copper and aluminium would also assist the attacking agents, and accelerate disintegration. In sea water a copper aluminium couple gives an E.M.F. of between ·486 and ·525 volt.

## THE APPLICATIONS OF ALUMINIUM.

H. Moissan. *Comptes Rendus.* April 10th, 1899.

The author states that Ditte regards the results obtained in his experiments as relative to pure aluminium, whereas his analyses show that the metal used by him was not first grade aluminium.

The metal produced to-day at the works of Heroult and of Secretan is almost pure, and contains neither sodium nor carbon. Tests are giving showing that while in 1893 the purest grades of aluminium obtainable contained between ·93 and 1·64 per cent. silicon, and between ·32 and 1·66 per cent. iron, the corresponding percentages of these two impurities in the metal of the present date are ·02 to ·13 per cent. silicon and ·12 to ·32 per cent. iron. This improvement in quality is chiefly due to M. Secretan's modifications of the Hall process.

The water tanks used in Madagascar were mounted on iron, and this fact explains their corrosion. As a set-off to the statements by Ditte that all the aluminium articles used in Madagascar which he has examined are corroded, Moissan states that he has seen numerous articles from that campaign which are practically unattacked, although bent out of shape and blackened with use. (Some of these articles were exhibited at the Academie des Sciences.) The state of the articles examined by Ditte may be due to their having been in contact with sea water in the hold of the vessel in which they were returned. Quotations are given from reports by regimental officers, all in favour of aluminium for camp outfits. The advantages of the metal for military service, as compared with tinned iron, are:—

1. Lightness; each soldier can carry 800 grams weight extra of ammunition.
2. No poisoning occurs from defective tinning.
3. No soldering of the vessels is required, as these are stamped out of sheet metal.

As regards Ditte's tests made by heating the metal and plunging it into cold water, such treatment would destroy any tinned iron utensil. The author has used aluminium in his own household for cooking purposes for three years, and these vessels are still in good condition; nor do they owe their preservation, as suggested by Ditte, to a protective coating of grease and dirt. A large hotel in Paris has a similar experience of one year with aluminium cooking utensils.

The advantages of aluminium may be summed up as (1) lightness; (2) an innocuous oxide; (3) capacity for being stamped.

The author closes by hinting that had M. Ditte lived in another age, he would have been found condemning iron, on account of its readiness to form an oxide and to rust on exposure to the air.

## THE APPLICATIONS OF ALUMINIUM.

A. Ditte. *Comptes Rendus.* April 17th, 1899.

A reply to the previous contribution by Moissan. The author states that he has taken note of the impurities in aluminium in his experiments. These impurities remain on the surface of the metal when it is attacked, and by breaking the continuousness of the layer of gases, they render the metal more liable to disintegration. In the course of his investigations he has examined not only the lower grades of aluminium, but also aluminium produced by M. Secretan in 1893, *i.e.*, the purest offered as a commercial product at that date.

With regard to the water-tanks used in Madagascar, copper was purposely used to strengthen the metal employed for these, and the results of his examination of the returned fragments confirmed the results of his laboratory experiments with such alloys of copper and aluminium. The vessels exhibited by him at the Academie des Sciences were not returned in the hold of a vessel, or in contact with sea water; for no traces of chlorine or chlorides could be detected on their surface. M. Moissan has presented to the Academie articles from Madagascar in good condition; the author has presented others that show considerable corrosion. The obvious conclusion that should be drawn is, that vessels of aluminium have a long or a short life, according to usage and circumstances.

The author has not made personal trial of aluminium cooking utensils, but has used forks and spoons made of the metal. These were washed daily with a solution of sodium carbonate to remove the grease, and under this treatment they speedily lost their polish and became pitted and rough.

All the articles exhibited to the members of the Academie (including those exhibited by M. Moissan) have been greasy, and to this layer of grease some of them undoubtedly owe their preservation.

The author agrees with Moissan when he says that "chaque application de ce metal demande une étude speciale, longue et delicate"; and states that he himself has recommended aluminium to the army authorities as the most suitable metal for water-bottles, and has suggested improvements in the design of such vessels, in order to facilitate their mechanical cleaning.

# FORCED CIRCULATION IN WATER-TUBE BOILERS.

When that foolish and extravagant experiment was made of putting flatly-inclined water-tube boilers into our big cruisers, the *Engineer* joined in the general acclamation. Recently, however, a leader appeared, which stated practically that it was impossible to expect such tubes to endure. It is pointed out that the tubes next the fire in a water-tube boiler are exposed to fierce heat from end to end, and must often be full of steam in place of water. The very small inducement to circulation which exists in a steam boiler is insisted upon, and the necessity of using larger tubes near the fires and providing free outlets at their upper ends.

We have long insisted on the folly of flatly-inclined tubes. Any tendency of steam bubbles to rise is reduced in a ratio corresponding with the sine of the incline. An inclination of 12° reduces the effect of gravity nearly five-fold. If water-tube boilers are to be a success, the tubes must be of necessity shortened down to a certain limit. Twenty-five diameters is the maximum allowed by the *Engineer* to be possible without bending effects being observed when under fire. Up to this length self-circulation seems to be efficient, or fairly so. It is all a question of water supply, and as we have before pointed out, the provision of a centrifugal circulating pump to draw water from the steam drums and force it to the tubes offers an apparent solution. Such a pump would simply be worked in a closed cycle. It offers no practical difficulties. The system is already at work in many industrial establishments. It is a large boiler which evaporates 600 gallons per hour, but it is a small pump which circulates 600 gallons per minute, and a very small expenditure of power would compel the circulation of water many times the volume of the evaporation.

It would not be difficult to so arrange matters that the lower tubes secured the larger supply. In the Belleville boiler the continuity of the tubes in vertical series demands such a system. Marine engineers accustomed to the use of circulating pumps for their surface condensers, might surely be expected to adopt similar means in the far more important matter of boilers. Until they do so, such boilers as the Belleville with flatly-inclined tubes and tubes in series cannot be considered safe even if made with solid drawn tubes. The serious bending of the tubes in the Belleville boiler is in itself sufficient to call attention to some serious internal trouble being present. Tubes full of water are not likely to bend in the most severe heat. The cooling effect of the water is so far and away beyond the absorbtive action of the external surface of the tubes in the fire that tubes would not become over-heated if they had a rapid current of water flowing inside them. Because such tubes may sometimes give way, and not kill half a dozen stokers, appears nowadays to be a sufficient justification for their use. But the tubes in water-tube boilers do not always produce small effects when they burst.

The Howard safety boiler killed many men, and so have others. Probably all the accidents of any moment which have happened to water-tube boilers have been due to over-heating due to want of water in the lower tubes. A forced circulation of sufficient amount would prevent such failures. Let us suppose a circulation of ten times the weight of water evaporated. On this basis how much of a tube would be occupied by steam and how much by water? Assume a pressure of 165 lbs. absolute. The relative volume of steam and water at this pressure is approximately 140 : 1. As only one-tenth is assumed to be evaporated, it is obvious that in a length of 14 inches of pipe only 1 inch is solid water. If the evaporation of the lower tubes is assumed to be double the average of the whole tubes—a moderate estimate—then only $\frac{1}{7}$th of the length of a tube is filled with water at the point where the tubes discharge to the headers. Treble the amount of circulation and this will be reduced to about $\frac{1}{10}$th. Now a tube must either be filled with foam of a specific gravity of about 0 10, or with alternations of water plugs and steam. A pipe of 4 inches will perhaps allow water plugs to exist 4 inches in length. Then the steam spaces will be 36 inches long.

If we have not made some error in the above calculations and assumptions, and, as regards the latter, we think we have understated, rather than overstated, unfavourable facts, it would appear that in the lower tubes of a water-tube boiler the bulk of water present is one-tenth that of the steam when the total circulation in the boiler is 30 times the evaporation. This means that all the water in a boiler must make a complete circuit every two minutes. We do not say that this would ensure safety; we do not say that more than this is not already secured by the natural circulation in the boiler. It may be that we underestimate the circulation which actually takes place. But we do not think we err in stating that whatever may be the facts, more circulation is necessary than is so far secured. We have, therefore, made the above simple calculation to fix certain ideas, and to point out how very little water can be present.

We might even go on to show that with a circulation of 1,000 per cent. of the evaporation, only 1 inch in three would contain a plug of water. As steam is not a good cooling agent, the cooling effect on tubes, if any water in them, is reduced in proportion as the amount of water is reduced. The fact that tubes show signs of overheating is, we take it, indisputable evidence that very little water is present. Seeing also that upper tubes do not suffer, it would seem desirable to leave the circulation in these to be accomplished naturally, and employ all the circulatory effort of the proposed pump to compelling circulation in the lower tubes.

## THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

SEVERAL excellent papers were presented at a recent meeting of this Society. One on "Boiler and Furnace Efficiency" may be quoted with advantage. It was presented by Messrs. R. S. Hale and W. B. Russell. They say the furnace should be roomy, and it should be brick-lined so as to secure a high temperature. Especially when the coal is poor should these points be attended to, and air leakage beyond the furnace must be particularly guarded against. There are points to all of which we have repeatedly called attention. The authors go on to say that a combustion of at least 15 lbs. of coal per square foot of grate must be secured when the boiler is doing its normal rating. Here, again, the advice is sound, as also is that to keep the evaporation per square foot of heating surface low.

Certain water-tube boilers suffer from air leakage, but the Thorneycroft boiler is highly spoken of. The Lancashire type of boiler is said to suffer from air leakage also, and it has a poor type of furnace. The furnace is the weak spot of the Lancashire boiler as regards its environment. Hence we say the boiler should be large, and we should expect rings of firebrick to help combustion. Mechanical stokers are not necessarily coal savers, but they may save labour and they may prevent smoke. They may also enable poor coals to be usefully burned. Down-draught grates have shown some good results, but too few tests have been made for final conclusions to be drawn.

A paper by Mr. Henning on "Boiler Explosions" was a plea for testing the materials of a boiler after a long period of work and after it had failed by explosion, from excessive pressure. Overheating produces the typical steel blue rustless scale, brightest at points where the heat has been greatest. Tests of such plates will show up the changes produced by overheating. The yield point will be low, the elongation large, as a rule, and the fracture will be altered in appearance. Overheated plates may be tested against strips of the same plate, cut and polished and overheated to redness at one end in a clear fire, then allowed to cool to a blue heat and quenched. Nicked at points where a change of colour occurs, and compared with the strips cut off plates overheated in the boiler itself, the fracture and colours will be a guide to a correct comparison, and the temperature may be estimated and conclusions drawn as to the behaviour between stay bolts. Generally, by carefully considered comparative tests, much may be learned. Mr. Henning endorses the opinion of English boiler experts that fair working conditions have never been proved to cause any deterioration of the quality of boiler plates. The bad condition of the plates in an exploded boiler has often, however, been used by the maker of the boiler to justify the contrary, probably a slight confusion of cause and effect.

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

15,166. "An improved form of electrically actuated railway signal." W. E LANGDON. Dated July 24th.

15,169. "Improvements in electric storage battery plates." R. KENNEDY. Dated July 24th.

15,178. "Improvements in the brushes of dynamos." F. J. CHAPLIN. Dated July 24th.

15,189. "Improvements in rail bonds for electric railways." F. H. DANIELS Dated July 24th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 25th, 1899, being date of application in United States.) (Complete.)

15,194. "Improvements in galvanic cells." W. B. BARRY. Dated July 24th.

15,203. "Improved electric elevated railway." L. J. BRUNS and H. R. OTTESEN. Dated July 24th. (Complete.)

15,210. "Improvements in electric arc lamps." F. G. CHAGNAUD. Dated July 24th. (Complete.)

15,219. "Improvements in spring motors." E. R. ROGERS and J. F. CUSHMAN. Dated July 25th.

15,268. "Improvements in electric lamps." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. W. Rice, jun., United States.) Dated July 25th. (Complete.)

15,309. "Improvements in insulating electrical conductors." W. W. COLLEY. Dated July 25th.

15,335. "Improvements in tubular conduits for electric wiring" T. TAYLOR. Dated July 26th.

15,343 "Improvements in electric telegraphs." E. W. SMITH. Dated July 26th.

15,359. "An improved primary battery for generating electricity." C. H. PRESTON. Dated July 26th.

15,365. "Improvements in electromotors." N. POPOFF. Dated July 26th.

15 369. "Improved arc lamp having two arcs in series." W. MATHIESEN. Dated July 26th. (Complete.)

15,370. "Improvements in secondary or storage battery." T. DE MICHAELOWSKY. Dated July 26th. (Complete.)

15,377. "Improvements in the insulation of armature plates in dynamo-electric machines." F. P. V. LECONTE. Dated July 26th.

15,404. "Improvements in electrical distributing fuseboards for concentric cables." J. R. WESTON. Dated July 27th.

15,407. "Improvements in apparatus for controlling electrically propelled trains." THE LANCASHIRE DYNAMO AND MOTOR COMPANY, LIMITED, and A. P. WOOD. Dated July 27th.

15,418. "Improvements in insulated electrical conductors or cables." H. EDMUNDS. Dated July 27th.

15,426. "An improved electric battery and process for constructing the electrodes for the same." A. TRIBELHORN. Dated July 27th. (Complete.)

15,438. "A new or improved electrolytic process and apparatus for the production of chemically pure cupric sulphate and copper." E. FRENOT. Dated July 27th. (Complete.)

15,440. "Improvements in electrolytic incandescent lamps." M. VON RECKLINGHAUSEN, A. VOGT, and NERNST ELECTRIC LIGHT, LIMITED. Dated July 27th.

15,460. "A new or improved tap-switch for electric incandescence lamps." G. GARDNER. Dated July 27th. (Complete.)

15,467. "Improvements in switches for breaking electric contact." N. G. KNIGHTON. Dated July 28th.

15,482. "Improvements in and relating to portable direct reading ohmmeters for measuring low electrical resistances." A. JAMIESON. Dated July 28th.

15,525. "Improvements in electric switches." R. W. H. HOFSTEDE-CRULL. Dated July 28th.

15,541. "Improvements in dynamo electric generators and motors." C. W. ATKINSON. Dated July 28th.

15,573. "A new or improved method of, and apparatus for, a combined system of electric light fittings and fire alarms, and for appliances connected therewith." C. C. METCALFE. Dated July 29th.

15,581. "A combined switch and ceiling rose or other fittings for electric lighting purposes." S. JEVONS and W. H. LLOYD. Dated July 29th.

15,583. "Improvements relating to electric cash register tills." W. SNELGROVE. Dated July 29th.

15,599. "Improvements in or relating to electric switches and like apparatus for making and breaking electric circuits." G. W. PARTRIDGE and G. K. B. ELPHINSTONE. Dated July 29th.

### ELECTRICAL PATENTS OF 1885 EXPIRING IN AUGUST, 1899.

We are informed by Messrs. W. P. Thompson & Co. that about 76 applications for electrical patents were filed in the month of August, 1885. Out of these only one has been maintained to run its full length of term, viz., 14 years, and being of considerable interest, we give a short abstract below:—

**9,527. "Improvements in motors for electric railways." T. J. Handford. (F. J. Sprague, United States.)** Dated August 10th. 1885. Motors for locomotives. The electro-motors are so arranged that the relative positions of the armature and field magnets will not change, and are so supported that any movement of the car body relatively to the wheels will not disturb the mechanical connection between the armature and the driving axle. The shaft of the armature is carried in bearings fixed to the pole pieces of the field magnets. At the centre of the driving axle are journals connected to extensions from the pole pieces, which maintain the armature at the same distance from the driving axle. The electro-motor is supported by springs from the body of the car, which may be adjusted so as to relieve the driving axle of dead weight to any desired extent. 3 claims.

### ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

#### 1897.

**17,528. "Improvements in spring jacks for telephone switchboards." J. E. Kingsbury. (The Western Electric Company, United States.)** Dated July 26th, 1897. Jacks for telephone switchboards are constructed in rows. A strip of insulating

material has a row of holes drilled in from the front, and a row of smaller holes from the back, one edge of the holes from front and back being in line. Inclined duct holes are then drilled, and the necessary saw cuts made for holding the springs in position. The metal thimble is fitted in front, and has a shank which is secured in the duct. There is an inner spring thimble or tube having a shouldered shank which lies partly in the duct. There is a central spring for making contact with the tip of the plug, and is secured in saw cuts. The thimbles are riveted to the strip. The plug has two metal sleeves to engage with the thimbles, and a central metal core. 6 claims.

**17,540. "Improvements relating to electric light fittings." H. Lea.** Dated July 26th, 1897. Several incandescent lamps are carried by holders on arms of a central support which is hung by a twin conductor from a ceiling rose. A ransluscent china bowl is suspended below the lamps by hooks and cords from the ceiling rose so as to be readily removable for cleaning. The cords pass through eyes on a body, which may be raised or lowered to adjust the height of the bowl relatively to the lamps. 2 claims.

**17,546. "An improved electric circuit-closing device." C. A. Hollstein.** Dated July 26th, 1897. The falling weight of, or operated by, an alarm or other clock or mechanism is arranged to complete the circuit between the contacts at a predetermined time. 1 claim.

**17,587. "Improvements in and connected with conductors for electric railways." W. L. Wise. (A. Skrotz, W. P. Allen and O. S. Kelly, United States.)** Dated July 27th, 1897. Relates to electric railways and tramways on the third rail system. The conductor is of angular section. In another form is rubbing surface for the collector, or it may be of other sections. It is mounted on insulating posts or insulators on the sleepers or guard rails, and is covered and protected by the covers and side shields supported on the insulators or conductors so as to leave a passage for the collector between the side and the guard rail. The side pieces may be omitted, and the parts may be duplicated for a return circuit. 10 claims.

**17,609. "Improvements in or relating to electric furnace." I. L. Roberts.** Dated July 27th, 1897. (Date applied for under Patents, &c., Act, 1883, Section 103, December 29th, 1896, being date of application in United States.) A sheet-iron casing provided with a hopper and a flue covers a travelling band which is carried by rollers, and is preferably of cloth woven from wire covered with asbestos. Two electrodes are carried in asbestos packed ball joints in the closed end of the casing, and are bolted adjustably to stationary curved slotted plates. They may otherwise extend downward into the casing, the ball joints being placed in the top of this, between the hopper and flue. Powdered materials are fed in by the hopper, and the electrodes, after being in contact at their ends, are gradually separated until they are parallel, or an arc may be started by placing pieces of carbon between the electrodes. The belt is slowly moved forward, carrying with it unacted on material enclosing a continuous layer of the product of the furnace. This may be delivered in the fused state, if the furnace is short, or otherwise may be broken off in lumps at the end of the furnace. The furnace is applicable for the manufacture of calcium carbide and carborundum, and for other purposes. 11 claims.

**17,676. "Improvements in coin-freed electricity meters." W. Emmet.** Dated July 28th, 1897. A beam is balanced so as to remain tipped up in the direction shown after a coin has struck the pan at one end, and to tilt in the opposite direction when liquid or sand from a hopper fills the vessel at the other end. In the first position the electric circuit is completed through a pair of upright contacts. According to the strength of the current used a solenoid attracting a lever sets a cam so that the valve of the hopper passes a proportionate quantity of liquid or sand. In the second position the beam completes the circuit with the pair of contacts so that the current passes through an impedance or resistance which reduces the light. 2 claims.

**17,694. "Improvements in and connected with electric lamps for cycles and other vehicles, and a device for attaching and adjusting same." J. Moores and H. O. Farrell.** Dated July 28th, 1897. A generator for use on a cycle or other vehicle consists of a permanent field-magnet, and preferably a shuttle armature, enclosed in a casing which is supported adjustably by an angular rod and clamps on a fork so that a friction wheel on one end of the armature shaft engages the inside of the rim of a wheel of the vehicle. The casing may support an electric lamp. The friction wheel may be wholly of India-rubber, or may be a metal pulley carrying an India-rubber ring; the India-rubber may be roughened or contain emery to improve its grip. 3 claims.

**17,696. "Improvements in and connected with armature cores of permanent magnet dynamo-electric machines." J. Moores and H. O. Farrell.** Dated July 28th, 1897. Relates to armatures. An armature core for permanent magnet dynamo-electric machines is built up of two strips of sheet iron, bent over at both ends and fastened together back to back, so that the bent portions together form arc-shaped pole faces. The radial parts may be narrower than the pole faces in which case stiffening plates are added. 1 claim.

**17,723. "An improvement in incandescent electric lamps." T. D. Farrell.** Dated July 28th, 1897. Relates to incandescent lamps. One or more filaments are arranged with parts conveying opposite currents placed as near together as possible. For this purpose, a filament may be doubled at the middle and wound into a flat spiral, with its ends either at the centre or outside; or it may be formed into a cylindrical or conical helix, and provided with a rod to support the middle of the filament. 4 claims.

**17,812. "Improvements in electric railway systems." J. M. L. Murphy.** Dated July 29th, 1897. Relates to electric railways and tramways on the sectional conductor system with switches operated electro-magnetically or otherwise. Two grooved sectional rails convey current from a battery on the vehicle to the switch, which connects the main conductor to the exposed sectional conductor. The subsidiary current excites the magnets, which attract the armature, and complete the circuit between the main conductor, and the sectional rail, by the wedge-shaped contact piece and the spring contacts. The magnets are then included in the main circuit to keep the armature attracted until the circuit is broken at the rail, when a spring acting on the rollers on the T end of the pivoted armature restores it and breaks the contacts. The main collector consists of a piece with rollers. It is mounted on a slide, and connected to a pair of fingers which bear in the grooved subsidiary sectional rails. 15 claims.

**17,820. "Improvements in the manufacture of electric cables and in apparatus therefor." W. S. Smith.** Dated July 29th, 1897. Cables with co-axial helices of wire separated with insulating material are formed by supplying the wires from a twisting machine, having several bobbins mounted on a disc. The main shaft also drives a die-plate by means of bevel gearing. The die-plate and tube are mounted in an ordinary press chamber, and the covered cable passes out of a stationary die. 2 claims.

**17,826. "Improvements in electric lanterns." O. C. Prasse.** Dated July 29th, 1897. Relates to lanterns for bicycles and other vehicles. An incandescent lamp is screwed into a conical reflector, fixed on a metal battery casing and provided with a glass front. The casing contains two round cells with porous pots and screw covers, which carry hollow cylindrical carbons. Perforations into inclined recesses permit escape of gas from the porous pots, and mercury is placed in these recesses to prevent leakage, if the battery is tilted. Zinc rods are supported by central rubber plugs in the cover. The cells are connected in series through the casing with springs supported in the hinged lid of the casing, when this is closed, and by a disconnecting switch. The porous pots may be charged with dilute sulphuric acid, and the outer cells with a solution of bi-carbonate of potash, sulphuric acid, and bi-sulphate of mercury. 6 claims.

**18,029. "An improved process for the manufacture of electrode plates for storage batteries." C. Marschmer.** Dated July 31st, 1897. A material for binding the active material to the supporting grid or frame consists of amber dissolved in dichlorhydrin or epichlorhydrin and mixed with alcohol. Reference is made in the provisional specification to Specification No. 12,250, A.D. 1896. 2 claims.

**24,833. "Improvements in and relating to electricity meters." J. Routin and C. E. L. Brown.** Dated October 26th, 1897. Relates to quantity and energy meters. A current is periodically sent through an electro-magnet which causes a pawl lever to rotate a ratchet wheel to some extent, the lever being returned against a stop by a spring after each such movement. The ratchet wheel drives a counter. For measuring quantity or total energy, the stroke of the lever is limited variably by a cam, attached to the indicating spindle of an ampere or wattmeter. The cam is freed by the lever when this returns; a fixed stop prevents any action of the pawl on the ratchet wheel while the lever is lower than the lowest portion of the cam. For measuring the duration of current, the cam is replaced by a stationary screw. The periodic current is supplied to all the meters on a pair of supply mains, by connecting their coils between one main and an earth plate, a condenser being interposed if the main current is continuous. The main is connected with a source of continuous current, which is periodically connected to earth by a switch operated by a clock. The period may be altered at different times of day, in accordance with the load in the generating station. The source of current may be an exciter for alternators supplying the mains. When the supply of current is from a transformer, the source may be a dynamo driven by a small motor supplied from the mains. 4 claims.

**25,307. "Improvements in or connected with drum armatures for dynamo electric generators and motors." V. A. Fynn.** Dated November 1st, 1897. Armatures for continuous or alternating current generators or motors. A slotted drum armature, the slots of which certain several superposed conductors or layers of conductors, is wound in such a manner as to avoid all solder joints, except those at the commutator. The conductors are wound on without previously forming the spools or sections, and those portions which are situated outside the slots are symmetrically arranged, and contained between two cylindrical surfaces, one of which passes through the bottom and the other through the top of all the slots. The invention is described as relating to a four-pole machine, each slot being supposed to contain only four conductors arranged in two layers. The inside connections are those at the commutator end, and the outside connections those at the opposite end. Such an armature would have 17 slots numbered 1 to 17, and the step would be from slot 1 to slot 5, from 2 to slot 6, and so on. It will be seen that after the formation of the first section, the conductors forming the bottom layer of slot 1 are in connection with those forming the top layer of slot 5, the end connections being bent upwards from one layer into the other about half way between the two slots. The same applies to all the other sections. 2 claims.

**25,306. "Improvements in switching gear for transformers, reactance coils, storage batteries, and the like." The British Thomson-Houston Company, Limited, and H. M. Hobart.** Dated November 11th, 1897. Switches for transformers, resistances, storage batteries, &c., for obtaining a fine adjustment. The turns are connected alternately to contacts arranged in rows. Conducting bars are arranged between these rows, and connected by a resistance from the middle point of which a wire leads to the main. Bridge pieces slide along the bars and connect alternately with the contacts in the row. The contacts are carried by, but insulated from, a carrier fitted with a nut which is reciprocated when the screw is turned. 2 claims.

**25,332. "Improvements in and relating to the jointing of electrical cables." H. E. Menier.** Dated November 11th, 1897. (Date applied for under Patents, &c., Act, 1888, Sec. 108, May 11th, 1897, being date of application in France.) Telegraph and other cables have the insulating material placed over a joint, compressed, while cooling and setting. Two half-moulds are hinged along one edge by a rod, and are locked when closed by a rod on the other edge. Two semi-annular elastic bags fit the hollow of the mould, and leave a central opening for the cable. The bags are provided with tubular extensions into which the tubes are fitted. The extensions through which the tubes pass are closed by caps. Glycerine, water, air, &c., is forced into the bags to produce an even pressure on the insulation over the joint. The bags may be modified, leaving only the outer end portions, the insulating material itself being forced through the pipes. 3 claims.

**25,333. "Improvements in and relating to telegraphic receiving apparatus." J. A. L. Dearlove.** Dated November 11th, 1897. Receiving apparatus for submarine and other similar cables is arranged with the suspended coil connected to the cable and to a pivoted light lever means of threads. The lever is connected to an influence machine, such as a mouse mill or to the secondary of an induction coil. The longer arm of the lever moves over the contacts, but is not in contact with them. Each of the stops is in connection with a separate coherer circuit, or two separate levers may be employed for receiving dots and dashes. The coherer may be of the filings form, or may be a partially-exhausted vacuum tube containing ball terminals. There is a relay in the local coherer circuit. The armature of the relay is in the local circuit including the recorder or translator. This local circuit also includes the decohering magnet, which may be a single stroke or operate an armature carrying serrated rods passing through the supports of the coherer. 5 claims.

**25,399. "Improvements in electrical measuring instruments." G. K. B. Elphinstone and A. C. Heap.** Dated November 12th, 1897. Current meters for alternating currents. A pivoted coil carrying a pointer or recording-arm, and controlled by a spring or weight is movable about a stationary soft-iron core between the ends of a laminated soft-iron magnet. This carries two sets of coils, disposed symmetrically to avoid magnetic leakage. One set carries the current to be measured, and may be in series with an inductive or non-inductive resistance if the instrument is used as a voltmeter. The other coils are connected with the movable coil by an adjustable inductive or non-inductive resistance. The coils magnetise the soft-iron circuit; a secondary current is induced in the movable coil circuit. The inducations are stated to be practically independent of the frequency and wave-form of the current. 2 claims.

**25,412. "Improvements in electrical transformers." The British Thomson-Houston Company, Limited, and H. M. Hobart.** Dated November 12th, 1897. Transformers are wound so as to allow free ventilation and also heavy insulation at the ends of the layers. Corner pieces are arranged at the corners of the core and then a few turns of bare copper strips to serve as the secondary are wound on. A ventilating space is thus left between the core and the coil. A layer of insulating material is then placed in position and the primary coils wound on, there being one or more fewer turns at the ends on each successive layer. The insulating layers project beyond the coils, and the insulation is thickened. Finally one or two layers of secondary may be wound over the primary. 4 claims.

**25,441. "Improvements in the preparation of accumulator plates." C. A. Bennert.** Dated November 12th. In making plates or electrodes, there is used lead oxide or lead peroxide prepared from white lead or lead hydroxide electrolytically formed such as by the process described in Specification No. 14,801, A.D. 1895. 1 claim.

**25,468. "An improved memorandum desk for use with telephones and for other purposes." C. Harryman.** Dated November 13th, 1897. Paper rolls are held in bearings in a bar by turn buttons, and are acted on by tension springs. The paper passes through a slot above and below a carbon sheet, between rollers geared together and actuated by a handle and under a cutter. One of the rollers is covered with rubber and is pressed upwards by a spring so that, by turning the handle the paper is drawn tight from the rolls. The cutter serves to sever the used paper. Only one roll may be used. The clips hold the transfer paper. 3 claims.

**25,530. "Improvements in apparatus for heating buildings and the like by means of hot fluids or electricity." J. A. Dargue, E. Griffiths, and C. H. Wright.** Dated November 13th, 1897. Radiators heated by fluids or by electric currents, are provided below with openings closed by flaps to admit fresh air. The heated air escapes by the grid above. A plate is provided to receive the dust deposited by the air. It is supported on centres or may slide in guides so that the dust can be easily removed by rotating or withdrawing it, or a scraper or the like may be employed to remove the dust from the plate. 2 claims.

**25,640. "Improvements in electrical resistance apparatus." F. Hughes.** Dated November 15th, 1897. An incandescent lamp is mounted as shown in section for controlling the supply of current to any apparatus, such as the lamp for examining casks, &c., described in Specification No. 8,135, A.D. 1895. The lampholder is carried by the non-conducting top of a perforated cylindrical metal casing which is fixed on a weighted non-conducting base and has a handle and a vertically sliding door. Four terminals, such as are provided in a groove in the edge of the base, two being connected to the lamp terminals, and the other two connected together. 2 claims.